THE MATHEMATICS TEACHER

Volume XXXIV  Number 5

Edited by William David Reeve

Mathematics in the Defense Program*

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THE American Mathematical Society and the Mathematical Association of America number some 5000 members. The American Mathematical Society is devoted primarily to the development of research in mathematics, and the Mathematical Association of America to the teaching of mathematics. About a year ago these societies appointed a committee known as the War Preparedness Committee, to prepare the two societies to be useful to our nation in time of war. The ways and means of doing this were not prescribed, but were left to the committee. Before I give you details about our organization and aims it will be helpful to make a few remarks concerning the role of science in defense in general.

The most effective employment of science in a defense program must include the use not only of the facts of science, but also of the methods and men. In time of war science must be resourceful and inventive and capable of *quick* analysis of emergency problems. The defense against the magnetic mine by the English is a magnificent example of the immediate application of theory to practice. Theoretical science can not be neglected; for it is the reservoir of general methods any one of which may be needed. But theoretical science should be in a form in which it can be quickly applied. We should further develop the technique of making applications.

This is particularly true of mathematics. North America leads the world in pure mathematics. We are also strong in the simpler applications appearing in ordinary engineering or industrial practice; but we have preferred experiment to theory and have tended to use the laboratory to obtain results which might have been predicted. This is in contrast to the situation in Europe, where tradition as well as material necessity have produced engineers with greater theoretical knowledge and training. This state of affairs should be

* Address delivered before the National Council of Teachers of Mathematics at Atlantic City on February 21, 1941 by Professor Morse. The part with special reference to the secondary field, and certain other sections, comprise the essential portions of an address by Professor Hart on "Mathematics for National Service" before the National Council at Baton Rouge, La. on January 1, 1941.

remedied; for in time of war we cannot take the time to experiment.

We are beginning to correct this situation. In this we are aided by a number of European experts of great talent and ability. Several of the leading authorities on aerodynamics of Germany are now refugees in this country. The leading mathematical authority on ballistics of Italy, is also a refugee and is lecturing in this country. In addition, there are a few Americans who are well trained in these fields. But these authorities are in such demand from industry for immediate purposes that they have little time for teaching or general education and research.

I have given you one reason why this bottleneck has arisen. There is another reason which goes very deep. It is our national suspicion of theory, on the part of the general public. We are perilously low-brow. This is dangerous in a democracy where the great motivating forces must come from the people. One result has been a lack of cooperation between the theoretically-minded scientist and the practically-minded scientist. The pure scientists have intensified their study of science for science's sake, and the applied scientists have adhered to "common sense" and the laboratory. It is one of the problems of education to show that the more mature and socially-minded way is to respect both theory and practice, and particularly their combination.

In this connection I wish to refer you to a pamphlet on *Science in War*, written by twenty English scientists during the last year. This book is in the Penguin series, costs twenty-five cents, and may be ordered from New York at any bookstore. It is an illuminating account of the success of science when used in the English defense, and of the difficulties in getting science used. Here are discussed the problems of nutrition, of agriculture, of stock-breeding and planting, and of the reactions of the Civil Service and tradition to these problems. There is the problem of rationing, of the hours of labor, of the care of the wounded and prevention of disease, the dispute between the artists and naturalists over camouflage, the uses of mechanical science, the problems of morale and propaganda. On reading this book one sees clearly the necessity in a democracy of an adequate understanding of science by the general public, and as a corollary the fundamental need of education in the methods and aims of science, as well as in the facts.

With the foregoing in mind I shall now describe the aims and organization of the War Preparedness Committee.

Our objectives may be listed under five heads:

1. *Research.* The solution of mathematical problems essential for military or naval science, or rearmament.
2. *Preparation for Research.* The preparation of professional mathematicians for such research.
3. *Education for Service.* The strengthening of mathematical education in our schools and colleges to the point where it affords adequate preparation in mathematics for military and naval service or rearmament.
4. *Military and Naval Texts.* The study by a large group of mathematicians of the current routine military texts and sources wherein mathematics is involved—to obtain *certain* knowledge of what should be taught in the schools and colleges, and in order that mathematicians may be able to aid in the revision of these texts if and when their aid is needed.
5. *Roster of Personnel.* The collection of specialized information concerning mathematicians, similar to that in the national roster but more detailed as to mathematical training; and the making of this information available to all scientific or military committees or organizations aiding in the defense.

To carry out these objectives three subcommittees were appointed with the following titles:

1. Research
2. Preparation for Research
3. Education for Service

It is the last committee, on Education for Service, in which you are naturally most interested, but I shall first tell you about the other two committees.

Committee on Research. This committee is headed by Professor Dunham Jackson of the University of Minnesota. It is ready to receive mathematical problems important for the national defense, and will seek to solve these problems. To aid this committee we have appointed consultants in each of six fields. These fields are as follows:

Aeronautics
Ballistics
Computation (numerical, mechanical, electrical)
Cryptanalysis
Industry
Probability and Statistics

The chief consultant in *aeronautics* is Professor Bateman of the California Institute of Technology. This is perhaps the most difficult of all the fields, and one of the most important. Thousands of hours of mathematical labor go into the design of each new type of aeroplane. There is the problem of the flow of air by moving objects and the problem of the determination of surfaces of least resistance and greatest lifting power. The problem of flutter is a very troublesome one, but nevertheless admits a mathematical approach. An essential tool here is the theory of conformal mapping. Those who wish further details may refer to a paper entitled "The engineer grapples with non-linear problems" by Theodore von Kármán, in the *Bulletin of the American Mathematical Society* of 1940.

The chief consultant in *ballistics* is John von Neumann of the Institute for Advanced Study at Princeton, New Jersey. The Government maintains its proving ground at Aberdeen, Maryland, and Dahlgren, Virginia, and has several able mathematicians at work in this field. These men are charged with the proper design of guns and projectiles, with their testing, and the making of tables. The problem of bombsights is also referred to them. An interesting discovery of the last few years is the close connection between the theory of projectiles and that of high speed aeroplanes. High speed projectiles move at a velocity somewhat greater than that of sound, while the maximum speed of aeroplanes is now nearly two-thirds that of sound. It is therefore natural that ballistics and aerodynamics should be intimately related. The speed of sound is critical for bodies moving in the air. The tremendous resistance met at this speed seems to indicate that the maximum velocity at which aeroplanes can fly is fast being approached.

Professor Norbert Wiener of the Massachusetts Institute of Technology is the chief consultant in *computation.* A great deal of the computational work at the Aberdeen Proving Ground is now done by mechanical means by the so-called Bush Analyser. This is an intricate and expensive machine occupying a large room and capable of giving the numerical solutions of an important class of differential equations. Since the original machine was set up at Massachusetts Institute of Technology some ten years ago, several larger and better ones have been built. In the whole world at the present time there are not more than ten such machines. Professor Wiener is working on the problem of using this machine or similar machines to solve partial differential equations. If accomplished, this would be an important aid for applied methematics. In spite of the existence of these machines, much computation still has to be done in the old-fashioned way. Fortunately for this country, we have a number of experts on numerical computation.

Cryptanalysis is the science of the making and solving of codes and cyphers. There is ample literature on the subject and by virtue of its intriguing nature it might appeal to students of high school age. The chief consultant is Professor Eng-

strom of Yale. Professor Engstrom is an officer in the Naval Reserve and with his aid a number of able young mathematicians are making an intensive study of crypt-analysis. It is possible to use the latest and most powerful algebras to make codes that are unbreakable. The catch is that complex codes are difficult to transmit without mutilation. Ordinary code theory involves a use of frequency tables and much ingenuity. It was only during the last war that the Germans discovered that it was better to employ statisticians than philologists in this branch of the military service. Here is a field in which mathematicians are very useful.

The chief consultant in *Industry* is Dr. Thornton C. Fry, Mathematical Research Director of the Bell Telephone Laboratories. There are more than fifty corporations employing more than 100 mathematicians. He finds that integral equations are used in prospecting for oil, matrix algebra in studying the vibration of aircraft wings, and in electric circuit theory, the calculus of variations in improving the efficiency of relays, the theory of numbers in the design of reduction gears, and in splicing telephone cables, and topology in the classification of electric networks. He points out that there is no place in this country where a mathematical consultant for industry can be trained as such. Such a man studies as an engineer, or a physicist, or a mathematician, and must be partially self-trained to serve as a mathematician in industry. Fry's plea for better training in the field confirms the emphasis of our committee on training in applied mathematics. Moreover, in this field the demand for men exceeds the supply.

Professor S. S. Wilks of Princeton University is the chief consultant in *probability* and *statistics*. I shall quote Wilks as follows: In a war emergency the greatest service which can be rendered by probability and statistics is of the nature of routine and practical applications. Because of the extreme importance of mass production techniques in modern warfare the feeling is very general that statistical methods of quality control such as those used by Shewhart in the Bell Telephone Laboratories would be valuable. Another main technique is that of sampling surveys and their application to the problem of stores and supplies, personnel selection, transportation, communication, etc. There is also the problem of statistical analysis of data obtained in bombing practice and in range firing.

Preparation for Research. The second main subcommittee on "Preparation for Research" is headed by Professor Marshall H. Stone of Harvard University. It is concerned with the professional education of mathematicians to the end that they may be available for research on mathematical problems of the defense. Up to date expositions of ballistics, aerodynamics and hydrodynamics are not available. This committee is concerned with this lack. It seeks to encourage the giving of special courses on applied mathematics in the various graduate schools, and a number of these courses are now being given. Bibliographies need to be published and special seminars on mathematics of the defense need to be arranged at various scientific gatherings. This is a work of great importance, but one that will take time. It is an essential part of the proposed development of applied mathematics.

Education for Service. The third subcommittee, and the one in which you are undoubtedly most interested, is on Education for Service. Its Chairman is Professor William L. Hart of the University of Minnesota. At my suggestion his committee embarked on a vigorous campaign of investigation of mathematical education in the secondary schools and of undergraduate mathematical education in the colleges, in relation to the national defense. The objectives as formulated by his committee are as follows:

1. To investigate what mathematics is of prime utility in industry and in the Army and Navy in the national defense.
2. In accordance with the results of this investigation, to make useful recom-

mendations in regard to mathematical curricula at both the secondary and college levels.

3. To determine in what ways mathematicians may aid in the preparation of textbook material and in the teaching of those who will have mathematical duties in industry or as enlisted men or officers.

Professor Hart conferred with the officers in charge of the R.O.T.C. at the University of Minnesota with teachers of aeronautical engineering, and with teachers of ground school courses in the Civil Aeronautics Program. He visited two warships and some major coast defenses of the Army, and examined the workings of a major aircraft plant. He has drawn upon his experience as a major of artillery during the World War. At my recommendation his committee obtained textbooks of a mathematical nature employed in the R.O.T.C., for ground school courses for pilots, and for various service schools maintained by the Army. No consideration was given to training at West Point and Annapolis because the officers from these schools are exceptionally well prepared for their duties. His report concerns mathematical aspects of the preparation of all others, officers or men, who will eventually enter the national service.

A representative sample of the military textbooks which such men would study was sent to various mathematicians to review. I have some of these reviews with me and shall be glad to show them to anyone of you who may be interested. I shall continue with a reading of parts of an address presented to the National Council by Professor Hart at Baton Rouge.

"One object of these reviews is to learn at first hand what mathematics is a minimum essential for the study of the texts and for the performance of field duties by officers and enlisted men in various branches of the military services. As a second object, in these reviews, we wished to observe the nature of the exposition of mathematical material in the texts, with the possibility in mind that mathematicians might aid in the construction of any future editions of the books. In this outline of my sources of information, I take pleasure in acknowledging assistance received by me from President Mary Potter of the National Council in connection with viewpoints for the secondary field and mathematics appropriate for skilled industrial workers.

"I shall now summarize some of the evidence at my disposal and then, later, I shall draw certain conclusions, principally concerning effects at the secondary level.

"Permit me to be very brief on the non-military side. It appears to me that the aircraft and munitions industries, with their demands for skilled workers and draftsmen, the drain on the national supply of skilled workers due to Army and Navy calls for enlisted specialists, and the statistical work associated with the activities of government agencies and industry, will operate to require largely increased numbers of men and women who have appropriate training in mathematics. It would be desirable if skilled workers in industry had substantial secondary mathematics, through the stage of computational trigonometry, with at least an intuitional knowledge of solid geometry, and with emphasis on numerical applications at all possible stages. For these non-military activities, as many women as possible should be trained at least through substantial high school mathematics; a more select group should be trained through the stage of elementary college mathematical statistics to create a reservoir of computers for government and industry.

"I evaluate the pure mathematical needs of the various Army and Navy services as follows, if we eliminate the requirements of those exceptional officers whose work can be designated as military research.

"*First*, the Infantry, motorized or not. Even this supposedly non-technical branch of the Army places demands on mathematics. All enlisted men in the infantry find use for arithmetic and intuitional geometry.

The officers, non-commissioned officers and private first-class should have familiarity with elementary geometry to permit map reading, map construction, appreciation of contour designations on maps, the use of coordinate systems. These men also should be able to appreciate the complicated mechanical drawings and the internal workings of the rifles, light anti-aircraft guns, and other materiel assigned to the infantry. In brief, for these men I would specify elementary algebra and geometry as frequently taught in training for industry. In addition the officers should have some acquaintance with the notions of probability and probable error as met in elementary statistics.

"*Second*, the *Coast Artillery Corps*. This exceedingly mathematical branch includes all artillery for seacoast defense, all high altitude anti-aircraft artillery, and all mobile artillery of heavy caliber. The officers of this corps have to perform the duties of surveyors on some occasions, and they deal with very complex optical instruments, motorized machinery, and complicated guns. These men should have very strong training in mathematics—in fact they should be engineering graduates as the most desirable stipulation. But, as a minimum, they must know mathematics through computational plane trigonometry, and elementary spherical trigonometry, with some background in solid geometry. They should also have an acquaintance with the notions of probability and probable error as met in elementary statistics, in order to appreciate the theory of gunfire. All enlisted men should have a background of geometric and algebraic knowledge equivalent to the training suitable for skilled workers in industry. In addition, about 25 per cent of the enlisted men should be as well qualified mathematically as the officers.

"*Third*, the Field Artillery, or light artillery. We can make the same minimum stipulations for mathematical training as in the Coast Artillery with the omission of mention of spherical trigonometry, and with somewhat less insistence on the need for mathematics in the case of the enlisted men.

"*Fourth*, the Signal Corps. The officers should be electrical engineers and the enlisted men should have the mathematical training suitable for skilled men in industry.

"*Fifth*, the Ordnance Dept. It needs various specialists, both officers and enlisted men, with highly mathematical backgrounds such as possessed by engineering graduates or college majors in mathematics.

"*Sixth*, flying officers in the Air Corps of the Army and Navy, and all other officers in the Navy. They require at least the same *minimum* training as officers of the Coast Artillery, because of the necessity for studying *navigation* in all present cases, aerodynamics and meteorology for air-force officers, and numerous other technical subjects. In fact, it bewilders a civilian, who has seen the workings of a warship, to conceive of any Navy officer who is not a trained engineer. These officers of the air-force and Navy should have substantial courses in solid geometry and spherical trigonometry, far beyond what is satisfactory for the artillery service.

"*Seventh*, the ground force of the Air Corps. It requires a large number of graduated engineers, men with college mathematics and physics especially for the meteorology section, and a large force of men with mathematical backgrounds suitable for skilled industry.

"*Eighth*, enlisted men in the Navy. All of them should have the mathematics suitable for skilled workers in industry. A substantial number of the enlisted men should be as well qualified as stipulated in the description of *minimum* mathematics for the officers.

"In summary, I believe that the preceding specifications of mathematical training for officers give minimum levels if our Army and Navy are to be well led. The training which I specified for various types of enlisted men may exceed the *true mini-*

mum but probably is the *desirable* level if it can be attained. I hazard the guess that, without special effort on the part of the high schools, colleges, and centers for adult training, the nation will *not* have a proper reservoir of men with the mathematics necessary for the needs of industry and the military services.

"Now let me present certain personal recommendations for viewpoints and actions as a consequence of the nature of the probable mathematical needs which I have just enumerated.

"Item 1. In the secondary field, it would be very undiplomatic and harmful if the national emergency were taken as a crude excuse for a violent attack on certain curricular trends, even though it is possible that weaknesses of some features of these trends may become apparent when analyzed under the searchlight of our present national requirements. I recommend that initially we should make our proposals and state the mathematical objectives in the preparedness program *without* any stipulation as to the pedagogical details involved in attaining the objectives.

"Item 2. The National Council of Teachers of Mathematics and all organized bodies of mathematics teachers at all levels should advertise the utility of mathematics in industry and military service. In high schools it should be advertised that Army and Navy R.O.T.C. units in colleges *require* trigonometry and *should require* solid geometry and spherical trigonometry.

"Item 3. I recommend that every club of secondary teachers of mathematics should promptly hold a special meeting devoted to a discussion of the role of mathematics in the present national emergency and to a discussion of possible local actions in the high schools.

"Item 4. I recommend that in the junior and senior high schools, every boy and girl of sufficient mathematical aptitude should be *urged* by the high school advisers, to take as much mathematics as possible, through the stage of trigonometry and some solid geometry, as a national service. And, I recommend that a *new definition of socialized mathematics* be adopted in the curricula for students of *all* ability levels, where we would recognize that, at least for boys, *mathematical content with military uses* is the most socialized variety of mathematics to which they can be exposed at present.

"Item 5. The military necessity for spherical trigonometry and space diagrams in many important places leads me to recommend that the high school course in solid geometry be given much more emphasis than in recent years. I suggest that it be modified by replacing some of the classical content with a treatment of the elements of spherical trigonometry, thus giving a combined course in solid geometry and spherical trigonometry. In fact, this combination appeals to me on purely mathematical and pedagogical grounds apart from the requirements of the preparedness program.

"Item 6. I recommend that a *single* set of courses be used for secondary students of *ability* in attaining the desired ends, rather than separate curricula, some designed to fit men for industry and some planned for men and women who will proceed more deeply into mathematics.

"Item 7. As a temporary measure, I suggest that boys of intelligence, now in grades 11 and 12, who have previously omitted substantial mathematics, should be offered an *abbreviated* treatment of logarithms, plane trigonometry, intuitional solid geometry, and an introduction to spherical trigonometry, to permit these students to train themselves rapidly for their practically certain entrance into skilled industry or the Army or Navy.

"Item 8. I advance the opinion that a severe shortage of men with engineering training is at hand. This should be brought to the attention of interested boys of mathematical ability in the high schools.

"Item 9. As a final recommendation for the secondary field I urge the National Council to appoint a special committee on

"Mathematics for National Service," to coordinate and direct appropriate activities in the secondary field."

The applications of mathematics in the national defense will be made by men in all branches of the national service and in the various scientific professions. Some of the men contributing in this way will be mathematicians. The one thing for which mathematicians are mainly responsible and in which they have the greatest influence, is the education in mathematics for this service. I know that we can count on the teachers of mathematics for the fullest aid.

Recent Resolutions of Interest to Mathematics Teachers!

1. A RESOLUTION adopted at the Conference of the Society for the Promotion of Engineering Education in Berkeley, California, June 24–28, 1940, against the postponement of mathematical education in secondary schools. This resolution was printed in full on page 324 of the November 1940 issue of THE MATHEMATICS TEACHER, and need not be repeated here.

2. A similar resolution passed at the regular annual meeting of the Northern California Section of the Mathematical Association of America, January 27, 1940, which was published on page 59 of the February 1941 issue of THE MATHEMATICS TEACHER and need not be repeated here. Similar resolutions were also passed unanimously by the Southern California Section and by the American Mathematical Society.

The following supplementary statement was added by the officers of the section:

"This resolution in no way implies that college preparatory courses should be required of all students. But these three organizations feel strongly the importance of continuing to provide *substantial courses in mathematics for those who need them in preparation for later work or for those who choose to elect them. We believe that, to be effective, these courses must begin with algebra in the ninth year.*"

3. The *War Preparedness Committee* of the American Mathematical Society and the Mathematical Association of America presented three resolutions which were adopted by the officers of these organizations. The first of these, pertaining to the high schools, reads as follows:

"That all competent students in the secondary schools take the maximum amount of mathematics available in their institutions. In the case of many schools additions to the present curriculum will be necessary in order to furnish an adequate background for the military needs of the country."

It was urged by the War Preparedness Committee "that these resolutions be given *immediate publicity* in order that the changes recommended may be undertaken *at once*."

Mathematics and the Defense Program*

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As we are all aware, the Defense Program consists primarily of two main efforts: industrial and military. Some would add a third, the effort for political effect. But actual preparations for defense involve first, the training and organization of army, navy, and coordinate services, and second the supply of materiel and the organization of industry and industrial personnel to provide the necessary supplies for the use of the defense services. An elaborate analysis would subdivide the program into a vast number of subsidiary programs, but unless we confine ourselves to a quite general discussion of how mathematics is related to these two principal problems—industrial and military preparedness—we shall be here until late this evening, or perhaps I should say that the speaker would still be talking if he knew enough about the subject, but the audience would long since have sought the freedom of the outer air.

Mathematics as a whole is probably most naturally represented by three organizations, the American Mathematical Society, the Mathematical Association of America, and the National Council of Teachers of Mathematics. It is the custom of these organizations to cooperate rather closely, and, as you know, they include representative men and women from all fields of interest in the subject. It is natural, therefore, to regard the report of the War Preparedness Committee of the Society and the Association as indicating the answer which American Mathematics is making to the question, "What role does Mathematics play in the Defense Program?" Consequently I shall use this report as a basis for outlining a few problems the consideration of which may prove interesting.

The chairman of the Committee, Prof. Marston Morse of the Institute for Advanced Study at Princeton opens the report with the following statement which I shall take the liberty of quoting,

> Very few understood that we had a *dual* mission, education as well as research. The engineer often underestimates the ability of the mathematician to focus on an application, and the mathematician underestimates the time and knowledge required to get to grips with a practical problem. Military authorities vary greatly. Some, like our representatives at the Proving Grounds, are very able, not only in their technical fields, but also in their use of the mathematics of today. Fortunately, those in high command in the army and navy are also aware of the function and possibilities of mathematics. This applies particularly to research. We have not found a general meeting of minds when it comes to the aid mathematicians can give in routine military education. This is largely the mathematicians' fault, because very few of us are abreast of present day developments in military science. It is a great mistake to think that the technical and educational preparedness of the military and naval authorities is like that of the Great War. A day spent in Washington in consultation with the various staffs threw much light on this question.

The Committee specifies three objectives for study and realization. They are:

1) The solution of mathematical problems essential for military or naval science, or rearmament.

2) The preparation of mathematicians for research essential for objective (1).

3) The strengthening of undergraduate mathematical education in our colleges to the point where it affords adequate preparation in mathematics for military and naval service of any nature. A study by a large group of mathematicians of the current routine military texts and sources wherever mathematics is involved in order that mathematicians may exert their proper influence on the teaching of military and naval science in time of war.

* Paper read at a meeting of teachers of mathematics in and around Fresno, California, on February 8, 1941 and also at the recent meeting of the Mathematics Section of the Bay Section of The California Teacher's Association.

It may appear that these objectives involve the activity chiefly of research institutes, universities, and colleges. But it must be remembered that the foundation for college and university work in mathematics is laid in the secondary and elementary schools. It is a problem for *all* of us, not just for a few specialists. I want first to mention three subcommittees which have been appointed to make this Committee's work effective and the services of mathematicians available.

1. The subcommittee on research. Problems would be received and assigned to suitable consultants for consideration. Consultants are available in such fields as *ballistics* (a subject having to do with the behavior of projectiles), *aeronautics*, *computation* (numerical methods of solution of differential equations, etc., mechanical computation), *cryptanalysis* (that is the construction and deciphering of codes), *probability* and *statistics*, as well as other special subjects.

2. The subcommittee on preparation for research.

3. The subcommittee on education for military and naval service. The War Department intends to use sections of existing texts for instruction in the military schools. Members of this subcommittee intend to read those few texts which involve mathematics with the idea of finding out *what elementary mathematics must be taught in order that these books can be readily understood*, and also to see in what way, if any, *the material in these books of a mathematical nature could be better written to save time and achieve the desired results*. It is clear, then, that constructive work of a quite general character is going forward.

We may next consider briefly what contribution graduate schools can make of a mathematical nature to the Defense Program. It seems clear that such schools should extend their courses in applied mathematics, such as dynamics, elasticity, aeronautics, ballistics, statistics, etc., and advanced students should be urged to become highly qualified in one or more fields of applied mathematics. Now it is evident that such work is in preparation for highly specialized jobs in industry or in certain of the highly technical divisions in the military or naval service. While not every top sergeant needs this training, it is obviously essential for the relatively few research technicians without which no modern military establishment can exist. What sort of work would these men be called upon to do? One or two simple illustrations will suffice to give an indication.

We consider the subject of *exterior ballistics* which is concerned with the flight of projectiles after they leave the gun. Most of us remember using the flight of a projectile as a very convenient and highly "motivated" example of the importance of knowing something about parabolas. Or it served as a chance to get some differential equations of motion which would integrate nicely much to the delight of the instructor if not of the student. Unpleasant complications were avoided by assuming that the projectile was obligingly set in motion in a vacuum and that it remained in this same vacuum until it reached the end of its trip. Its trajectory was easily found in terms of the formulas

$$x = v_0\, t \cos\theta$$
$$y = v_0\, t \sin\theta - g\, t^2/2.$$

From these the trajectory could be "computed." By this is meant that x, y, and z coordinates of the center of gravity of the projectile, and the x, y, and z components of velocity of the projectile can be calculated for any given time t. We suppose, for example, that the origin is at the muzzle, that the x-axis is horizontal and that a plane through it and the gun is vertical, that the y-axis is vertical, and that the z axis is horizontal and, therefore, at right angles to the direction of the gun. In such a case the z coordinate of a point on the trajectory would indicate the distance of the point to one side or the other of the vertical plane in which the gun is placed. This distance is called the *deflection*, and in our handy vacuum, this will be zero. Unfortunately, the military people do not have vacuums in which to shoot at an en-

emy, and, consequently, cannot use these convenient formulas for indicating the path which a projectile may be expected to follow.

The primary difficulty is to be found in accounting for the resistance of the air. For a given projectile the resistance of the air increases very rapidly with the speed of the motion. For a 75 mm. gun the muzzle velocity is approximately 1500 feet per second. For velocities below and not too near the velocity of sound,and also for velocities considerably above that of sound, the resistance is roughly proportional to the square of the velocity, the constant of proportionality being considerably larger in the second case than in the first. In the intermediate zone, the change is much more rapid still. The following table gives an idea of this change:

$v < 790$	$R = A_1 v^2$	
$790 < v < 970$	$R = A_2 v^3$	
$970 < v < 1230$	$R = A_3 v^5$	
$1230 < v < 1370$	$R = A_4 v^3$	v in feet
$1370 < v < 1800$	$R = A_5 v^2$	per second
$1800 < v < 2600$	$R = A_6 v^{1.7}$	
$2600 < v < 3600$	$R = A_7 v^{1.55}$	

The A's are constant coefficients, but so chosen as to give a resulting function which is continuous. The existence of a critical region about the velocity of sound is to be accounted for by the fact that much of the energy of the projectile is dissipated in setting up wave motions in the air, and the general character of the disturbance is quite different according as the projectile moves slower or faster than the waves which it creates. This has assumed that the air is at standard temperature and density. Here is another complication, but it will be passed over.

The constants of proportionality just mentioned must be adjusted by the use of what is known as the "ballistic coefficient" which must be determined experimentally for each projectile. Other complications enter. When all are finally taken into account, the differential equations of motion can be set up, and initial conditions specified. In order to "compute the trajectory," some method of solving these differential equations is necessary. In general, it is impossible to express their solutions in terms of quadratures. Numerical methods are available, and I have with me a booklet on the method of numerical integration of such equations written by Professor Dunham Jackson of the University of Minnesota and kindly lent to me by the Ordnance Unit at Stanford and from which I have borrowed some of this data. In recent years machines have been devised which will compute the numerical solutions of such equations in comparatively short times. Computation of trajectories "by hand" is very tedious, and it requires several days to compute a set of tables.

It should be remarked that the problem of "low-angle firing"—that is of guns inclined to the horizontal at a small angle is one thing. High-angle firing, required for anti-aircraft guns, is another. Further complications are introduced.

There is an account of "The Mathematics of Exterior Ballistic Computations" in the *American Mathematical Monthly* for November 1940, and I refer you to this for a half hour's interesting reading.

By this time it should be clear that mathematical training of a high order is needed for certain experts in ordnance work. I might remark that during 1917–1918 there was a group of mathematicians working on methods for solving these ballistic problems at the Aberdeen Proving Ground.

We have heard much recently about bomb-sights. The United States is reported to be in possession of a superior type whose design is a secret. Most of us have probably thought very little about the construction of such an instrument. When I first read of such a bomb-sight, I at once conjured up a mental picture of some kind of small tube through which a man in an airplane would squint, and when he saw his objective through the tube, he would let go a bomb. The tube could probably be made out of an old piece of gas-pipe with a few deft applications of a hack-saw and file. This is, of course, monstrously absurd.

The problem of proper aiming is far from simple of solution. A bomb is let fall, and it descends to the ground while acted upon by forces due to gravity and air-resistance. The magnitude and direction of the latter depend upon the velocity and direction of motion of the bomb with respect to the air. To be brief, it is necessary to predict the effect of these forces under various conditions, and to incorporate these predictions into a mechanical device which will indicate to the pilot of the plane when to drop the bomb and what course to fly. The latter is essential, for the velocity and direction of the plane at the instant of release of the bomb are the velocity and direction of the bomb itself. Bombing from airplanes is the subject of a chapter in the standard ordnance text used by the Army, and I have with me a copy of this text in case anyone cares to glance through it after this talk. It will appear that in the design of bomb-sights, some complicated differential equations are involved, and Mathematics enters again into this discussion.

It is hardly necessary to remark that the problems of airplane design involve considerable mathematical difficulty. The equations of turbulent flow of air about the wing surfaces are complicated. The proper shapes for such wings form a subject for mathematical treatment. Some of you may have read an article in the December number of the *American Mathematical Monthly* entitled "Mathematical Problems in Aviation," and I refer you to this article for further elaboration. To illustrate the fact that the mathematics involved is not altogether simple, I might relate my experience with proceeding from one line to the next in an article in a periodical devoted to such problems. A statement (familiar to us all) was made to the effect that "evaluation of the integral in regard to x" obviously produces the result written at once in the next line. Well, the evaluation of this integral, while straightforward enough, required two pages of yellow scratch paper. That was just one line. There were others!

Mathematical questions are involved in naval architecture. It is important to find the volume, say, of the hull of a ship. Its shape is known, and cross sections can be accurately described. The solution of such a problem requires, usually, a method of numerical integration, and various formulas have been developed to handle it. Such rules as Simpson's Rule are, of course available, but occasionally more advantageous methods can be devised for the problem at hand. The point is that competent mathematicians are useful. "Handbook engineers"—to use the phrase of one of my class mates—will do, but are less valuable. I might remark that most of the merchant shipbuilding which is now going on in and near San Francisco is done from designs sent from some eastern office. In such an office, our mathematics is needed.

One other type of service which can be performed by a properly trained applied mathematician is the preparation of such a "training movie" as was shown to our Stanford Mathematics Club two weeks ago by Capt. Soares of our Military Department. In this film the forces acting upon projectiles were graphically portrayed in a masterly fashion. Such a film could not be made by anyone not thoroughly conversant with the mathematical theory involved.

I have mentioned just a very few of the applications of mathematics to problems which arise in actual combat branches of the army or navy, in construction of necessary implements of defense, or in training personnel. These are intended merely to suggest the need for highly trained specialists—men who must be trained in our graduate schools. There is a multitude of other such applications. You are probably thinking of many right now. But we must turn to other matters.

Before speaking of the contribution which undergraduate colleges and the secondary schools can make to the Defense Program, I should like to recall the fact that there are two distinct sides to the Program. One is the military side; the other is the industrial. While the former is closely connected with the latter, it is con-

venient to keep the two separate for purposes of discussion. Since I shall have occasion to mention the Army, Navy, Marine Corps, and other branches of the Service frequently in what follows, I should like to sketch the organization of one of these, the Army. The others are similarly organized.

The Army may be roughly divided into two services, the Arms or Combat Services, and the Supply Services. In the Combat group we find Infantry, Cavalry (both horse and mechanized), Field Artillery, Coast Artillery, Air Corps, Signal Corps, Engineers, etc. In the Supply group we find the Quartermaster Corps, Ordnance, Finance, Adjutant General's Office, to some extent the Signal Corps, Engineers, Air Corps, etc. To consider just one of these divisions briefly, we find the Ordnance Department—which, by the way, is at present organized on virtually a wartime basis—concerned with two main jobs. First, the design and manufacture of ordnance equipment. This involves a technical staff of specialists in mathematics, chemistry, engineering, and so on. Second, the field service which is concerned with the acceptance, inspection, and supply of ordnance materiel to the army in the field. Probably the most nearly indispensable department in the Army is the Ordnance, for an Army can fight while hungry, it can fight if ill-clothed, or ill-housed, or half sick, or muddy, or flea-bitten; but it can't do much if it runs out of ammunition. And mathematics is the very backbone of ordnance.

Let me now quote to you the recommendation of the War Preparedness Committee of the Society and Association which applies to colleges and universities. "Colleges and Universities should at once make such revisions of their undergraduate courses in mathematics and add such courses to the curriculum as are necessary to prepare students in the elements of mechanics, probability, surveying, navigation, and other essentials of military service." Many colleges now have units of the Reserve Officers Training Corps. Stanford, for instance, has Field Artillery and Ordnance Units. But these are special departments which train a limited number of reserve officers in the special duties of their possible later positions in the Army. It is the broad training in fundamentals of mathematics, sciences, English, history which the colleges provide which is important, not only for those who may later enter actual military service, but for those who participate in the industrial phase of the Defense Program.

An interesting illustration of what the university can do to help meet the need for mathematical training of men actually engaged in Defense work may be found in the proposed work to be undertaken by engineering colleges in twenty-seven regions of the country. Several million dollars have been appropriated by Congress to finance this program. Stanford, for instance, has made plans to give a series of courses under this arrangement which will be of use to the civilian employees of the National Advisory Committee for Aeronautics laboratory at Moffett Field. You may recall reading of the establishment of this laboratory as one of the main centers of aeronautical research under government auspices. One of the courses contemplated is a course in engineering mathematics which will include the discussion of ordinary differential equations, hyperbolic functions, elliptic integrals, infinite series, a little about Fourier Series, Gamma and Bessel Functions, partial derivatives and some partial differential equations, and vector analysis. While this is especially intended for the Moffet Field personnel, it will be open to all qualified students.

Completion of some college mathematics, say through the first course in calculus, is essential for the commissioned officer in some branches of the Army or Navy service, and I am told that it is advisable for all. With the calling up of large numbers of reserve officers, who are not West Point or Annapolis men and who have not, therefore, had the regular mathematics courses there prescribed, we begin to hear of the part our college mathematics train-

ing plays in their duties. Just last week we received a letter from one of our Mathematics graduates of the class of 1936 who held a reserve commission in the Ordnance Department. He is now at March Field at Riverside, and he writes:

> So far everything is OK and I haven't found any rocks in the clouds while out flying. What am I doing? Lots and lots of routine work, pencil pushing and all of that stuff. As my specialty I still dabble a little in the mathematical end of things. Been doing some investigation into the ballistics of aerial gunnery, and the theoretical side of bombing. I assure you that it is no easy matter. You have to make a whole fistfull of assumptions, work your head off on that basis, and then hope that everything you assumed was correct and will check against the actual results when you can verify the work in the field. Starting the first of February I am going to teach classes in gunnery and bombing to all the new officers who are being sent here for training.

It is hardly necessary to remark that there is a great number of jobs in industry which can be filled only by well trained engineers, and in their training a full course in high school and college mathematics is indispensable. In fact, the whole technical side of production of equipment is based on just such education.

We now turn to the subject of perhaps greatest interest, and certainly of very great importance in our discussion. Let me quote the statement of the War Preparedness Committee of the Society and Association again. "All competent students in the secondary schools should take the maximum amount of mathematics available in their institutions. In the case of many schools additions to the present curriculum will be necessary in order to furnish an adequate background for the military needs of the country."

It is, of course, perfectly obvious that the fullest possible mathematical training should be given in the high schools for the benefit of those students who will go on to the college, and perhaps graduate school, for some of the specialized training for work which has just been indicated. The role of college preparatory school is familiar to us all, and I omit detailed reference to it.

Many high school graduates will enter some branch of the military training program, either by their own or Uncle Sam's choice. With what are they confronted in their attempt to advance? Some will try to work for commissions. Here certain very definite requirements must be met. As an example, consider those for admission to the Flying Cadets of the Army Air Corps. Among other things, each cadet must have documentary evidence of his graduation from or satisfactory completion of two years' work at a recognized college or university. If he can't show this evidence, he must take an educational examination. The topics listed are United States history, English grammar and composition, general history, geography, arithmetic (as covered in Wentworth's *Higher Arithmetic*), algebra (as covered by Hart's *College Algebra* or any *other recognized textbook of equivalent standard*), geometry (as covered by Wentworth's *Plane Geometry* or any other recognized textbook of equivalent standard), Trigonometry (as covered by Wentworth's *Plane Trigonometry*) and Elementary Physics. It might be pertinent (or maybe impertinent) to observe that the standard texts suggested are not such things as "Socialized Mathematics," or "Humanized Geometry"—we're in the Army now! These required subjects are given in practically all high schools. The student who has had these courses is just that much better off—provided, of course, that he can retain the skill and knowledge gained in his class work.

You may be interested to hear a word about what extra effort is actually being made by high schools to help young men achieve the knowledge necessary to qualify them for advancement in some of the military services. I take as examples the evening school work at the Palo Alto High School and at the Mountain View High School, both of which draw upon the personnel of Moffett Field. At this air base there is, naturally, a large corps of enlisted men who are not pilots, ground mechan-

ies, meteorologists, flying cadets, non-flying cadets, etc. These men are anxious to qualify for advancement. In order to rise from the first four ranks—that is, private, private first class, corporal, or sergeant, to a high non-commissioned rank such as staff sergeant, technical sergeant, or master sergeant, it is necessary to take an examination. This is true in any branch of the military service, and naval and coast guard, marine corps, and other services have similar requirements. These men from Moffett Field find that they must secure the idea of positive and negative numbers, the ability to solve simple equations, to handle simple formulas, to solve simultaneous linear equations in two unknowns, the trigonometry of the right triangle, and a familiarity with other fundamental mathematical ideas and processes such as handling ratio and proportion, percentages, etc. Mr. Fuller at Palo Alto tells me that the former commandant of Moffett Field who is now in Washington on the General Staff remarked that no single thing is more necessary to these men than the ability to handle a few of these simple things in mathematics, and that this is the biggest problem in the educational program of the Air Corps. In the course of a year or so at Palo Alto some three or four hundred men have sampled the evening courses in mathematics and shop mathematics. I understood Mr. Fuller to say that from 80% to 85% have been flunking much of this work! Most of these men have been out of high school for a few years, and they might normally be expected to have some trouble recalling knowledge which was acquired as long ago as their first year or two in high school, but we have an indication here of how important continued experience with mathematical work of some type or other is in maintaining the skill once obtained. Students who have had no high school mathematics have a hard time getting anywhere, and the attendance in the classes is inclined to be somewhat irregular. Although total enrollment is maintained at about the same level, "turnover" may be great. One reason for this is that as soon as one of these men gets his mathematics, the Air Corps "snatches" him.

At Mountain View High School the experience with the Moffett Field enlisted men is similar to Palo Alto's. Mr. Carter, who is in charge of the evening school work, described the men as presenting an exceedingly diversified background of mathematical experience. Some have had no mathematics whatever, some have had four years of high school mathematics and simply need a review course to help prepare them for examinations for Flying or Non-Flying Cadets. The Army furnishes transportation to and from the school. It is easy to imagine the difficulty in giving any sort of survey course in the subject to a class in which there will be represented a score of different kinds of preparation. It has developed pretty largely into work on a more or less individual basis. Many of the young men are enthusiastic and ready to do big things, but when they discover that they can't learn algebra and trigonometry in two weeks, they become discouraged and are apt to drop out.

It seems clear that the high schools, especially those near military or naval bases, can be of considerable service in providing night courses for enlisted men or others who need certain mathematics courses to prepare them for advancement. For some the regular college preparatory mathematics is needed—for instance for those men I have mentioned who wish to qualify as Flying Cadets. For others, shop mathematics is more important, for instance for men who wish to advance to the Non-Flying Cadet, ground mechanic, or materiel groups.

So far, these remarks seem to have concerned chiefly men who are actually in the Army or other military or naval services, or those who expect to enter such services and who, therefore, must have as much mathematics as they can get in their high school programs. I have also seemed to consider almost solely the needs of Army men with little or no consideration of other

branches. The fact that spherical trigonometry is important for the study of navigation has, for instance, not been touched upon. But each of us can extend the application of these few remarks to cover these other Services.

We must not forget the other side of the Defense Program, namely industrial production. We have heard a lot about "bottle necks" in recent months. I cannot refrain from reading to you an item from last week's *New Yorker* headed "Block that metaphor." It runs as follows: "Los Angeles, Dec. 10.—A new bottleneck in the military aircraft expansion program today is poking its threatening head from the inside of a vicious cycle to hamper production." At the present time, one of the chief bottle-necks—with or without a "threatening head"—in all of our production effort is the shortage of skilled labor. This work does not require a college degree, but it is none-the-less important. Men doing such work need what is frequently termed "shop mathematics"—you are all aware of the type of mathematical training needed, and I shall not attempt any elaboration. Among other things, shop workers should be able to read drawings. It is reported that Douglas Aircraft has had such difficulty in securing men for this skilled work who can read plans, that is has been necessary to furnish isometric drawings—that is drawings which are essentially pictorial representations—for the use of its skilled workers. There is no time to stop to train all of these men on the spot. Some experience in their high school work would help to solve such a problem. Incidentally, it may be of interest to note that a new bombing plane involves some five thousand drawings.

It would appear, then, that in the future, emphasis may well be put upon shop mathematics for the non-college preparatory students. In fact, it is rumored that the Federal Government may become sufficiently interested to provide some extra funds for courses in the high school which will serve to prepare young men as skilled laborers.

As I interpret the results of my meager investigation of the subject of the role which mathematics can play in the defense effort, there are three essential tasks for us to perform. One is to see to it that every young man who has any aptitude in working with his hands, who does not plan to go on to college, and who will eventually want to become a skilled worker, has the opportunity to secure training in shop mathematics in his high school course. This is absolutely necessary for the continuation of our industrial system, and its importance is obvious. The second task is to provide an opportunity for men who are actually a part of the military establishment—at whatever level—to secure the type of mathematical training which is needed in the proper discharge of their duties, and which may prove helpful to them in advancing in the Service. The third task is to continue to provide adequate training for technicians and for research workers who must bear the responsibility of furnishing the experts without whom a modern form of military and naval preparedness is completely impossible. As far as I know, I may soon be serving my country by digging ditches in the ground over at Fort Ord, serving as an ordinary private under some of my former students whose reserve commissions have blossomed into active duty. But, I shall feel that I have performed an important service to the cause of our national defense if this little talk has in some way served to strengthen your conviction—that mathematical training of a high order is absolutely essential in building up an adequate defense for our country—that any movement which tends to reduce the amount of mathematics now available in the college or the high school is highly dangerous—and that we must continue to work together for the preservation of high standards of excellence and of service in our profession.

The Mil as an Angular Unit and Its Importance to the Army*

By Richard S. Burington
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In the Army of the United States, two systems for measuring angles are in wide use; the *mil* system and the familiar *sexagesimal* system. In the mil system, the fundamental unit is the *mil*, where by definition 1600 mils equal one right angle. In contrast, in the sexagesimal system, the fundamental unit is the degree, where 90 degrees equal one right angle. Radian measure is also used to some extent by the Army. Most American mobile artillery units as well as many heavy railway mounts have the scales on their sights, azimuth circles, and quadrants graduated in mils, and some of these units have their scales graduated in both mils and degrees. The mil is also employed to a large extent by the Infantry.

The *mil* gains its name from the fact that one mil is approximately the angle subtended by one yard at a distance of 1000 yards. This simple approximate relation makes the mil well adapted to certain types of practical rapid calculations. It is principally for this reason that the mil system is used extensively in several branches of the Army.

In view of the preceding facts it is obvious that many of the students now studying secondary or college mathematics will shortly find knowledge of the mil system highly desirable. However, the mil is mentioned in practically none of the current geometry or trigonometry texts and is seldom included in trigonometry courses at present. Hence, the Sub-Committee on Education for Service of the War Preparedness Committee recommends that teachers of trigonometry add to their courses work involving the mil system along with the usual material on radian measure. The following types of exercises should be included (the reader will no doubt want to add many more types).

1. Convert the angle 36° 10′ 20″ into mils.
2. Convert the angle 22 mils into degrees, minutes, and seconds.
3. Convert the angle 0.7 radians into mils.
4. Convert the angle 19 mils into radians.
5. Draw an angle: estimate its value in degrees; radians; mils.
6. How many mils are there in the central angle intercepting an arc of 20 inches on a circle of 25 inches radius?
7. What length of arc at 2000 yards will 3 mils intercept?
8. A circular target at 5000 yards subtends an angle of 2 mils, at the edge. What is the diameter of the target?
9. From the position of an observer, an automobile 20 feet in length at right angles to the line of sight subtends an angle of 2 mils. What is its distance from the observer?

Problems involving the solution of triangles where the angles are measured in mils, should also be included.

The student should be given some field practice in estimating angles in mils; and he should be encouraged to work many problems involving the principles encountered in Exs. 6, 7, 8, and 9, approximately and without the use of pencil and paper.

Teachers at the secondary level should note that problems like the preceding Exs. 1 through 9 could be included in the course in plane geometry if radian measure and related principles are discussed.

For the convenience of the reader a few conversion factors are listed below.

90 degrees	=	1600 mils
1 degree	=	17.77778 mils
1 minute	=	0.296296 mils
1 mil	=	0.05625 degrees
1 mil	=	3.37500 minutes
1 radian	=	1018.6 mils
1 mil	=	0.0009817 radians

* Prepared at the request of the Sub-Committee on Education for Service of the War Preparedness Committee of the American Mathematical Society and the Mathematical Association of America.

Where the Importance of Mathematics Need Not Be Taught

By EDNA M. JONES
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THE imperative need for relating mathematics to other subjects without devoting courses merely to the practical, social and business aspects of the subject has been significantly stressed in the national reports of both the Joint Commission on the Place of Mathematics in Secondary Ecucation and the Progressive Education Association on Mathematics in General Education. In most places our subject matter is on trial for its place in the secondary school curriculum. But there are exceptions.

Teaching in the secondary school of the U. S. Marine Corps Base at Quantico, Virginia, this mathematics teacher is unconcerned lest she "be too absorbed in . . . adoration of the muse of mathematics to be blinded to [her] surroundings and to the needs of those who have not been initiated into the order of the Pythagoreans."[1] Comprehension of mathematical theories, and skill and accuracy in the application of mathematical techniques are vital to the activities which, especially in this time of national emergency, are unceasing in the military services of the country. And the children of aviators, tankmen, gunnery sergeants, and anti-aircraft specialists encountering discussions of these techniques in their daily life find their own activities limited if they remain ignorant of the work of the "Pythagoreans."

After I had explained elementary trigonometric functions in the ninth grade algebra class, the students immediately diverted the discussion from the conventional, textbook material to the methods by which trigonometry is used in the new anti-aircraft guns, which measure, automatically, the height and speed and location of planes in flight. This led to an examination of transits used by men about them on the Post.

The standard, classical problems of a man rowing up or down stream prove incredibly artificial to my advanced algebra students, who have so often taken over the complete class hour in order to calculate the speed of planes, normally flying at a certain rate, but landing in a head wind of particular velocity. (They taught their instructor that planes sometimes land backwards, or at a negative speed!) This class all but demanded instruction in the manipulation of the slide rule, a much-used instrument in the Service. The graphing of quadratic equations is greatly simplified for boys and girls accustomed to thinking of bullets traveling in parabolic curves and they know, too, that projectile paths are not always parabolic and are eager to investigate the reason for this.

Seniors taking plane trigonometry quickly think of surveying problems and practical applications of the theorems they have studied—after all, how can an officer bridge a stream without knowledge of trigonometry?

This atmosphere of practical problems made comparison of mathematical and physical methods virtually inevitable, and with most fruitful results. The parallelogram of forces was taught simultaneously in the physics and trigonometry classes and when both groups understood the theories involved and could skillfully handle the techniques, a joint period was held under the supervision of the two teachers. Problems were presented first by the science instructor, and the physics students

[1] J. S. Georges, Wright Junior College, Chicago, Illinois, "Training Teachers of Junior College for Relational Thinking," January 1941 (Vol. XXXIV, No. 1), THE MATHEMATICS TEACHER.

solved them by means of scale drawings, while the trigonometry students employed mathematical formulae and skills. The second series of problems was presented by the mathematics teacher and the solutions were handled in the same manner. We discovered that the physical solution was more rapid for problems with figures up to three places. When the numbers had four or five places, however, the mathematical solution was more rapid as well as more accurate. The two classes were in this graphic manner convinced of the validity of both methods and learned the advantages and disadvantages of each.

The practical applications of plane geometry are less dramatic than those of trigonometry, but they have more often been used directly by the students. Boy Scouts and children of civil engineers, for example, know how to use the congruency theorems to measure distances, but have never before understood why these methods were correct. Thus, the practical creates a less rarified atmosphere in this course of logic.

The mathematics courses at the Post Children's High School at Quantico are titled in the traditional manner, but the military life provides that continuity of subject matter advocated by the J. C. R. report almost as successfully as the integrated four-year course program being recommended in so many quarters. Until we get away from the compartment system of teaching secondary mathematics, according to a recent report,[2] it will be impossible to create a really educational program in mathematics. Yet without abolishing the classical differentiation, the curricula here has acquired a fluidity, which functions very much as does the prescribed one.

Many of the male students have a more artificial stimulus toward proficiency in mathematics: they expect to compete in the difficult Naval Academy examinations. But the compelling necessity to understand what goes on about them is the main component in this situation where mathematics need not dwell in the realm of the purely intellectual—where mathematics need not be pigeon-holed into departments—where, unbelievably, the importance of mathematics need not be taught!

[2] William Betz, Public Schools, Rochester, New York, "The Present Situation in Secondary Mathematics, with Particular Reference to the New National Reports on the Place of Mathematics in Education," December 1940 (Vol. XXXIII, No. 8) THE MATHEMATICS TEACHER.

Enriched Secondary Mathematics*

By WALTER W. HART
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SECONDARY school pupils now include over 90% of the youth of this country between the ages of twelve and twenty, scattered variously in Grades 7 to 12. They have not been subjected to rigid standards of promotion in the previous grades, as formerly, so that they are more alike in chronological age than in intellectual age, or in achievement in separate subjects. Many, if not a majority, however, have had richer school and extraschool experiences than pupils formerly, have had their initiative and independence developed, and have been encouraged to seek ways of catering to their own needs and interests, real or fancied. They will not be required to follow a regimented education.

Categorical statements about the presecondary mathematical experiences of these pupils are rendered difficult by the fact that not all of these pupils have been in junior high schools, and the fact that curriculum and teaching practices vary in junior high as well as in elementary schools. Nevertheless the following characteristics of previous instruction in mathematics in Grades 1 to 6 may fairly be assumed.

The major effort in elementary mathematics is to develop skill in computing with arithmetic numbers. This is legitimate when it is made a means and not the principal purpose of the instruction, and when the range of numbers used and the kind and degree of skills sought are those necessary for the solution of the problems that may properly be proposed for the pupils in these grades. There is evidence that these limitations are not observed.

A second aim of the instruction is to develop ability to solve problems encountered by the pupils in home and school life, with gradual extensions to the fields of business, vocational, and community life. In many schools, techniques of solving problems are taught; in many, pupils have difficulty deciding what operations to perform to solve a given problem. The problems appear usually as means of affording practice in some arithmetic skill being taught.

There is reason for doubting that the pupils secure desirable understanding of the nature of and of the laws of the fundamental operations, and of the reasons for performing the operations in the customary manner.

Thus: $3+5=8$ and $5+3=8$ are taught as if they are essentially different facts and as if one is more difficult to learn than the other. It would appear preferable that children learn as early as possible the substance of the commutative law of addition, because that would halve the number of the addition combinations to be learned.

One recommended way of teaching that $3+5$ equals 8 is to separate an 8-group into a 3-group and a 5-group. This procedure fails to stress in desirable manner the meaning of addition.

Addition of halves, fourths, and eighths is often done informally or intuitively. While this procedure may prepare for, it certainly is not a substitute for the general process of adding unlike fractions.

That there are many instances such as these may be inferred from the statement of Professor Judd that the objectives of arithmetic are not a lot of separate skills but should be general ideas or principles.

The pupils necessarily are taught new ideas by the teacher instead of learning them from their text books; they work as a class rather than as individuals; they get limited understanding of mathematics beyond computation; they get little experience with either inductive or deductive development of the many rules that they

* Substance of an address before The National Council of Teachers of Mathematics and members of the Mathematical Association of America and of the American Mathematical Society at Baton Rogue, La. December 30, 1940–January 1, 1941.

use; they often acquire positive dislike for mathematics.

Even without the foregoing premises, it would have been possible to state that enriched mathematical experience in the secondary school must come from new understandings, habits, skills, ideals, attitudes, appreciations, and emotional reactions, because these are the categories of objectives for any course. The listed premises suggest specific objectives of each kind that are appropriate.

The emphasis in all instances is on that which is *new*, because only then will there be growth and interest. This quality suggests that former emphasis on skill in computation should be cut. This strikes at once at the too general practice of beginning a course in mathematics with a formal inventory test on arithmetic skills, followed by drills on computation. Established educational psychology indicates that skills should be tested and be retaught only to necessary extent, and that they be maintained as much as possible thereafter by use in natural situations. The practice of formal testing leads to a lot of overdrill that destroys the interest of pupils and wastes time.

That which is new may be new in *degree* or in *kind*.

Thus: An *enlarged* understanding of arithmetic numbers may include emphasis on reading, writing, rounding off, and using large numbers, something that is not appropriate for the lower grades. These objectives will furnish opportunity to use the various fundamental skills, and to rationalize the operations with integers.

New understanding of numbers may include instruction about and use of literal numbers, signed numbers, irrational numbers, and imaginary numbers, as and when these are appropriate in particular courses.

Similarly, when they are appropriate:

New habits of thinking should include practice in making generalizations (inductive thinking) and in making inferences (deductive thinking).

New habits of learning should include learning from experiments and from a text.

New habits of working should include working in small self-controlled groups, and, ultimately, alone.

New skills should include skill in using formulas, graphs, tables, squared paper, and equations.

New ideals should include those of checking, verification, and proof, system and order in presenting mathematical solutions, persistency in attacking problems.

New attitudes should include respect for mathematics, and confidence in ability to master it and use it.

New appreciations should include understanding that mathematics is more than arithmetic, that it is the product of inventive minds of the past, and that it is essential in solving socially significant problems of the present.

New emotional reactions should include replacement of fear of and dislike for mathematics by courage in efforts to learn it and by interest in it.

Informed teachers know that pupils need enriched mathematical experience notwithstanding the judgment of many educationists. Moreover they are quite right in insisting that, for some pupils, this enrichment should be secured by using modernized courses in algebra and geometry.

Alternatively, teachers of mathematics should admit that, for other pupils, the enrichment may be accomplished to more purpose by use of subject matter other than a complete course in algebra or geometry. This is already being done very well in modernized courses in the junior high school where formulas and equations make it possible to eliminate the "case" method of solving percentage and interest problems and to solve certain problems of mensuration, where graphs are used with good effect in studying statistics, and where intuitive geometry furnishes the necessary foundation for intelligent study of the mensuration formulas and furnishes experience in inductive thinking. In fact, the enrichment of the courses in these

grades has already proceeded to the point where there is danger that the pupils may get mental indigestion.

In the upper junior high school year or the first year of the older four-year school, there is a bottle-neck of heterogeneity due to the fact that here there has been, traditionally, a break in the aims, selection of subject matter, and teaching procedures. The result is a rapid growth of new type courses. These new courses started as efforts to provide for retarded pupils who were in the ninth grade. They have gone beyond that because they are being offered now as substitutes for algebra for all pupils.

A preferable alternative was foreshadowed by Professor David Snedden thirty years ago when he advised that high schools offer two sequences of courses in mathematics: one, a sequence consisting of modernized courses in algebra and geometry, and the other a sequence for pupils whose needs and interests are not met by the more traditional sequence. For convenience, refer to this new sequence as social mathematics. This proposal was ridiculed, and criticized as impossible for administrative reasons. Present day administrators are settling this last difficulty by postponing algebra to the tenth grade for *all* pupils.

It *will be most unfortunate* if teachers today fail to do what Snedden advised and, in organizing a sequence of courses in social mathematics, fail to enrich them above the level of grade school arithmetic.

For an enriched ninth-grade course in social mathematics, the following specifications are offered.

Observe all the categories of objectives that were listed earlier in this discussion. In doing so, stress understandings, modes of thinking, ideals, attitudes, appreciations, and emotional reactions, as much as if not more than skills of high degree.

In providing for renewal of arithmetic skills, do so when and to the extent that they are needed to solve the problems, whose solution is the major aim of the course. Maintain these skills as much as possible by using them.

Teach new tools that can be, and only those that will be used in solving the problems; in particular, the meaning and use of formulas, graphs, tables, and equations of the form $ax = b$, from algebra, and certain elementary concepts from geometry. None of the problems of social significance that are likely to appear in this course necessitate ability to solve other types of equations taught in elementary algebra, and the same may be said of much that appears in intuitive geometry. If these tools have been introduced in a prior junior high school course, ability to use them can be tested and revived if necessary. If they are retaught, there should be emphasis on understanding and on improved habits of thinking about them and working with them. There is no place for the fictitious puzzle-type problems commonly found in the algebra course.

Let the major aim of the course be the solution of socially significant problems. Since many or most of the types have been met in earlier grades, enrich present contact with them by solving them by means of the new tools (and these do help), by organizing them in new ways to increase their social significance, and by extending them to levels higher than were legitimate in the lower grades.

Develop all principles and rules inductively, permitting the pupils to generalize and making them aware of the inductive technique.

Teach the meaning and informal use of signed numbers, for they appear in everyday quantitative situations.

Definitely try to stimulate a desire to study the more traditional courses. To accomplish this, have brief exploratory previews of algebra, geometry, and trigonometry.

These specifications are designed to elevate the ninth grade social mathematics course. Having provided a rich ninth grade social mathematics course for those pupils who appear unready for or disinclined to

study algebra, teachers of mathematics should:

Plan other rich courses for a sequence of courses in social mathematics.

Enrich the courses of the traditional sequence, insisting that this sequence as well as the other start in the ninth grade normally. Failure to start this sequence there is unfair to the capable pupils, especially to those who have had the benefit of modern junior high school courses in the two previous grades.

Plan for switching from one lane to the other of this proposed two-lane mathematical highway, in-so-far as such switching is feasible and desirable.

The Twenty-Second Annual Meeting of the National Council of Teachers of Mathematics Atlantic City, New Jersey

By EDWIN W. SCHREIBER, *Secretary*

THE 22nd Annual Meeting of the National Council of Teachers of Mathematics was held in Atlantic City, New Jersey, February 21–22, 1941, at the Hotel Chelsea. Approximately 350 were in attendance at this meeting and 320 registered.

The general theme was "Mathematics in a Defense Program." A total of 18 sessions was held during the two-day period and the program proceeded with very little alteration as printed in the February issue of THE MATHEMATICS TEACHER, pages 51–55.

The luncheon for state representatives and delegates was presided over by Mr. Kenneth Brown, Chairman of State Representatives, and was a highly delightful occasion. Mr. Brown stated to the group that the membership in the National Council has increased approximately 400 since the fall months.

The annual exhibit was under the direction of Mr. Fred L. Bedford of Jersey City and was a very interesting display of high school and college Mathematics. It was well attended by a goodly number of teachers.

The discussion luncheon, held in the Wedgewood Dining Room, was attended by 220 guests. The presiding officer at this function was Dr. Maurice L. Hartung of the School of Education, University of Chicago, and a member of our Board of Directors. The preliminary duties for this luncheon were capably taken care of by Mr. Howard F. Fohr of Montclair, and his committee. The centerpiece of each table consisted of one of the regular geometric solids with the table number indicated upon it. Each guest received a favor of a geometric solid. The favors were of various colors of cardboard. The entire function was a complete success from the standpoint of a social function as well as a discussion function.

The Hospitality Committee, under the chairmanship of Miss Marion Lukens of Camden, are to be congratulated upon the tea which was served in the Music Room at 4:30 p.m. on Friday, February 21. 180 guests were served at this tea and all seemed to have an enjoyable time. The Mathematics Association of New Jersey presented each guest with an attractive mechanical pencil.

The Annual Banquet, held in the Wedgewood Dining Room on Saturday evening at 6:30 p.m., was a gala occasion. 157 attended this function. Our president, Miss Mary A. Potter of Racine, Wisconsin, received a beautiful floral tribute from the New Jersey teachers. Miss Potter introduced various members of the local committee, past presidents, and past officers of the National Council. Secretary Schreiber made a brief report on the attendance at the Annual Meeting, stating that representatives were there from 17 states and Canada. The Address of the evening was ably presented by Dr. Albert A. Bennett of Brown University on the subject, "Mathematics in a Defense Program."

First Meeting of the Board of Directors
Friday, February 21, 1941
English Hunting Room—8 a.m.

PRESENT FROM THE BOARD: Miss Mary A. Potter, F. L. Wren, Edwin W. Schreiber, Miss Vera Sanford, M. L. Hartung, Rolland R. Smith, Virgil S. Mallory, A. Brown Miller, Miss Dorothy Wheeler, C. M. Austin, Miss Hildegarde Beck, and H. W. Charlesworth.

ABSENT FROM THE BOARD: E. R. Breslich, W. D. Reeve, W. S. Schlauch, and Miss Kate Bell.

OTHERS PRESENT: Kenneth Brown and E. H. C. Hildebrandt.

Miss Mary A. Potter, President of the National Council of Teachers of Mathematics, called the meeting to order and asked Edwin W. Schreiber, Secretary-treasurer, to read the minutes of the previous annual meeting. The motion was made by Mr. Wren, seconded by Mr. Mallory, and carried that the minutes be accepted as read.

Mr. Austin read a letter from Professor E. R. Breslich, first vice-president, to the effect that he was unable to attend the convention because of serious eye trouble.

Mr. E. H. C. Hildebrandt, Chairman of the Committee on Multi-Sensory Aids, made a brief report concerning the committee.

Professor W. D. Reeve, Editor-in-chief of THE MATHEMATICS TEACHER and the Yearbooks was unable to be present because of illness but wrote to the effect that 5000 copies of the 16th yearbook have been published and are to be sold at $1.25 per copy. It was moved by Mr. Mallory, seconded by Mr. Schreiber, and carried, that Professor Reeve be instructed to proceed with the 18th yearbook on Multi-Sensory Aids and keep the Board informed of progress.

Mr. Wren reported briefly on the progress of the Dictionary of Educational Terms.

Mr. Kenneth Brown was presented to the Board and made a brief report on the present status of state representatives. Mr. Brown reported an increase in membership of about 400 new members since November 1940.

Mr. Edwin W. Schreiber, as treasurer, presented his financial report. It was moved by Miss Sanford, seconded by Mr. Mallory, and carried, that the report be accepted subject to audit.

It was moved by Mr. Austin, seconded by Mr. Wren, and carried, that a Committee on Radio be appointed by the President. Mr. A. Brown Miller, of Cleveland, was appointed Chairman of this committee.

President Potter brought up the problem in connection with negro education in the United States and no official action was taken.

The meeting adjourned at 10:00 a.m.

Second Meeting of the Board of Directors
Friday, February 21, 1941
Room #E—10 p.m.

PRESENT FROM THE BOARD: Miss Mary A. Potter, F. L. Wren, Edwin W. Schreiber, Miss Vera Sanford, W. S. Schlauch, M. L. Hartung, Rolland R. Smith, Virgil S. Mallory, A. Brown Miller, C. M. Austin, Miss Hildegarde Beck, and Mr. H. W. Charlesworth.

ABSENT FROM THE BOARD: E. R. Breslich, W. D. Reeve, Miss Kate Bell and Miss Dorothy Wheeler.

OTHERS PRESENT: H. C. Christofferson, R. L. Morton, Allan R. Congdon, and Miss Martha Hildebrandt.

Mr. Schreiber read an invitation from the University of Chicago, which is celebrating its 50th anniversary in September, 1941, to participate by sending a delegate. It was moved by Mr. Wren, seconded by Mr. Austin, and carried, that the National Council of Teachers of Mathematics be represented at the 50th Anniversary of the University of Chicago and that the President be the official delegate.

It was moved by Mr. Schlauch, seconded by Mr. Mallory, and carried, that the President appoint a committee to see what educational service the high schools could render in the defense program and report any findings to the Board.

Mr. A. R. Congdon, Chairman of the Committee to Study the Problem of Selecting Directors by Geographical Distribution, submitted the following report:

"Your Committee feels that the geographic distribution of directors has some decided advantages which deserve investigation.

"It is also convinced that other problems with which the National Council is confronted merit further study.

"It is therefore recommended that a committee be appointed to study the activities and services of the National Council with the purpose of extending those services so as to effect a long time program of activity which will challenge the interest of all groups in all sections of the United States which should be vitally interested in the teaching of Mathematics at all levels."

Respectfully submitted,
H. W. Charlesworth
Martha Hildebrandt
Edwin W. Schreiber
H. C. Christofferson
A. R. Congdon, Chairman

It was moved by Mr. Schlauch, seconded by Mr. Wren, and carried, that the above committee be continued to function as a committee and report on specific recommendations as to changes in the by-laws to make the National Council more effective in its service program.

Mr. Christofferson made a brief report on the coordination of the National Council with the Central Association of Science and Mathematics Teachers.

Mr. Hartung made a brief report on the National Commission on Cooperative Curriculum Planning. It was moved by Mr. Wren, seconded by Mr. Mallory, and carried, that Mr. Hartung continue to represent the National Council on this Commission.

It was moved by Mr. Austin, seconded by Mr. Mallory, and carried, that President Potter be reimbursed the balance of her railroad fare to the Baton Rouge Meeting.

Two mimeographed resolutions were presented; one from Mr. Cairns, Secretary of the Mathematical Association of America and the second from Mr. William Betz of Rochester, New York. No official action was taken in regard to these resolutions.

It was moved by Mr. Wren, seconded by Mr. Mallory, and carried, that the policy in the future programs of the National Council should be to the effect of appropriating a definite amount for feature speakers and that the supervising officers of the meeting are to determine who the feature speakers are.

It was moved by Mr. Miller, seconded by Mr. Hartung, and carried, that the traveling expenses of the President and Vice-president in a winter or summer meeting be paid providing that the total expenses of any such meeting do not exceed the amount appropriated.

It was moved by Mr. Schlauch, seconded by Mr. Mallory, and carried, that all of the traveling expenses of the President and Secretary-treasurer be paid to attend the Annual Meeting and that the balance of the amount set aside for transportation expense be pro-rated among the remaining officers and directors.

The meeting adjourned at 12:30 a.m.

Third Meeting of the Board of Directors
Saturday, February 22, 1941
English Hunting Room—4 p.m.

PRESENT FROM THE BOARD: Miss Mary A. Potter, F. L. Wren, Edwin W. Schreiber, Miss Vera Sanford, W. S. Schlauch, Rolland R. Smith, Virgil S. Mallory, A. Brown Miller, Miss Dorothy Wheeler, C. M. Austin, Miss Hildegarde Beck, H. W. Charlesworth, and R. L. Morton.

ABSENT FROM THE BOARD: E. R. Breslich, W. D. Reeve, Miss Kate Bell, M. L. Hartung, J. O. Hassler, and L. H. Whitcraft.

OTHERS PRESENT: Miss Martha Hildebrandt, Raleigh Schorling, H. C. Christofferson, John P. Everett, Miss Marie Gugle, and Wm. Betz.

This meeting of the Board of Directors began with a tea sponsored by President Potter which was very much enjoyed. Miss Marie Gugle, past president of the National Council, presided at the tea table. All past presidents attending the Atlantic City Meeting were invited to this session of the Board.

It was moved by Mr. Austin, seconded by Miss Wheeler, and carried that Mr. Kenneth Brown be employed for another year as Chairman of State Representatives. His salary is to be the same as last year.

It was moved by Mr. Mallory, seconded by Miss Sanford, and carried, that Professor Edwin G. Olds' Committee of the 17th yearbook be given an appropriation of $450.00 for the use of his committee. (The committee has already received $50.00.)

Mr. Schlauch presented his report as auditor of the Secretary-treasurer's accounts and also those of the President and stated that he found both correct. Mr. Schlauch also informed the group that the present net worth of the National Council as of January 31, 1941, was $14,075.91.

It was moved by Mr. Miller, seconded by Mr. Schlauch, and carried, that $690.00 be appropriated for the next Annual Meeting.

It was moved by Mr. Wren, seconded by Mr. Mallory, and carried, that $200.00 be set aside for the next Summer Meeting and that $300.00 be set aside for the next Winter Meeting.

It was moved by Mr. Mallory, seconded by Miss Beck, and carried, that $250.00 be appropriated by the Council for state representatives.

It was moved by Mr. Schlauch, seconded by Mr. Wren, and carried, that $150.00 be allowed for the President's office.

It was moved by Mr. Schlauch, seconded by Mr. Charlesworth, and carried, that $150.00 be allowed for the Multi-Sensory Aids Committee, including Mr. Hildebrandt's work and also Mr. Miller's. (This committee may draw on the contingent fund if further aid is needed.)

It was moved by Mr. Mallory, seconded by Mr. Wren, and carried, that $655.00 be allowed for the Secretary-treasurer's office.

It was moved by Mr. Mallory, seconded by Miss Sanford, and carried, that the President appoint a committee to investigate and report the "Shortages of Teaching in Mathematics"—THE MATHEMATICS TEACHER to be used as a medium for reporting the findings of this committee.

It was moved by Mr. Schreiber, seconded by Mr. Wren, and carried, that the Meeting adjourn. The meeting adjourned at 6:05 p.m.

The Annual Business Meeting of the National Council of Teachers of Mathematics
Saturday, February 22, 1941—8:30 a. m.—Room C

President Potter called the meeting to order and asked the Secretary, Edwin W. Schreiber, to read the minutes of the preceding Annual Meeting. It was moved by Mr. Charlesworth, seconded by Mr. Mallory, and carried, that the minutes of the previous Annual Meeting be approved as printed in the May 1940 issue of THE MATHEMATICS TEACHER.

It was moved by Mr. Austin, seconded by Mr. Johnson, and carried, that the Secretary be instructed to send letters of appreciation of their services to the National Council, to Professor W. D. Reeve and Professor E. R. Breslich, both of whom were unable to attend the meeting because of illness and to extend to them the solicitations of the National Council with the fond hope that they will soon be restored to normal health.

Secretary Schreiber announced the successful candidates as follows: R. L. Morton, Second Vice-President, and Kate Bell, J. O. Hassler, and L. H. Whitcraft, Members of the Board of Directors.

It was moved by Mr. Christofferson, seconded by Mr. Wren, and carried, that we extend a vote of thanks to our retiring directors, Mr. Hartung, and Mr. Smith.

It was moved by Mr. Hartung, seconded by Mr. Adkins, and carried, that the following resolution be adopted and a copy of same sent to the parties concerned:

"The officers, directors, and members of the National Council wish to express their sincere thanks to the members of the various local committees for the efficient

and gracious manner in which they have carried out their functions and to the management and employees of the Hotel for their courteous attention to our needs. We deeply appreciate the efforts which have been made to make our meeting pleasant and profitable."

It was moved by Mr. Wren, seconded by Mr. Miller, and carried, that the treasurer's report be accepted as read. Mr. W. S. Schlauch audited the treasurer's report and found it correct.

Mr. A. Brown Miller of Cleveland made a brief report on radio transmission as far as Cleveland high and grade schools are concerned and also invited members of the Council to assist him in furthering radio service for educational purposes.

Mr. Lazar made a brief report on what the New York City teachers are doing with reference to radio.

Mr. Wren spoke briefly on the 17th yearbook.

The meeting adjourned at 9:30 a.m.

The National Council of Teachers of Mathematics

Report of the Treasurer
Edwin W. Schreiber, Macomb, Illinois
For the Year, February 9, 1940 to January 31, 1941

Balance on hand at beginning of year:			
Union National Bank at Macomb	$1,553.72		
Savings Bank Deposit	2,640.61		
Commonwealth Edison Bond, 3½%, June 1, 1968	2,077.27		
	6,271.60		
Net loss on Book Value of Bond	1.50		$6,270.10
Receipts for the year:			
Mathematics Teacher, W. D. Reeve	$1,552.70		
Bureau of Publications, Yearbooks	1,885.82		
Interest on Bond	70.00		
Interest on Savings	27.55		3,536.07
			$9,806.17
Expenditures for the year:			
St. Louis Meeting:			
Directors' Expenses	$ 400.00		
Program Speakers	300.00		
Local Committee	19.25		
Printing Programs	47.06		
Incidentals	19.02	$ 785.33	
Milwaukee Meeting		196.30	
Baton Rouge Meeting		274.70	
President's Office		150.00	
Arithmetic Committee		386.94	
Executive Secretary, Salary		450.00	
State Representatives		300.00	
National Curriculum Planning Committee		25.00	
Secretary-Treasurer's Office			
Ballot Expense	$ 160.00		
Postage and Supplies	150.00		
Stationery	38.91		
Incidental Expense	27.70		
Secretary Service	150.00	526.61	
Contingencies		116.29	3,211.17
			$6,595.00

Statement of Assets in Treasurer's Office
January 31, 1941

Commercial Bank Deposit	$1,081.57		
Savings Bank Deposit	3,437.66		
Commonwealth Edison Bond, 3½%, June 1, 1968	2,075.77	(1940)	(1939)
	$6,595.00	$6,271.60	$6,682.62

(Signed) EDWIN W. SCHREIBER, *Treasurer*

The above report of receipts and expenditures has been audited and found correct.

(Signed) W. S. SCHLAUCH, *Auditor*

Attendance at Atlantic City Meeting
National Council of Teachers of Mathematics
February 21-22, 1941

CANADA
- Ontario
  - Rourke, Robert E. K.*

COLORADO
- Denver
  - Charlesworth, H. W.*

CONNECTICUT
- Greenwich
  - Werner, Paul*
- Hartford
  - Wheeler, Dorothy S.*
- Lakeville
  - Northrop, E. P.
- New Haven
  - Whitworth, Ernest*
- New London
  - Speirs, E. Elizabeth*
- Waterbury
  - Kilbourn, Ellery C.

DELAWARE
- Dover
  - Algard, Harry E.*
  - Hertlin, Lillian*
- Wilmington
  - Lynam, Lela*

DISTRICT OF COLUMBIA
- Washington
  - Albert, Gertrude (Mrs.)*
  - Amig, Margaret*
  - Grubbs, Ethel Harris*
  - Lewis, Mrs. Portia*
  - Long, Grace H.*
  - McCamman, Carol V.*
  - Smith, Ethel*
  - Schult, Veryl*

FLORIDA
- Winter Haven
  - Hart, Walter W.*

ILLINOIS
- Charleston
  - Hendrix, Gertrude*
- Chicago
  - Hartung, M. L.*
  - Johnson, John T.*
- Evanston
  - Donalds, Elliott R.*
- Macomb
  - Schreiber, Edwin W.*
- Maywood
  - Hildebrandt, Martha*
- Oak Park
  - Austin, C. M.*

INDIANA
- Culver
  - Syer, Henry W.
- Muncie
  - Shively, L. S.*

IOWA
- Cedar Falls
  - Kearney, Dora*
- Iowa City
  - Short, Harry
  - Spitzer, Herbert*

LOUISIANA
- University
  - Karnes, Houston T.*
  - Yates, Robert C.*

MARYLAND
- Baltimore
  - Benner, Elisabeth
  - Berry, Dorothy
  - Coard, Leanore M.
  - DeHoff, Naomi
  - DeRan, Jeannette
  - Garbode, Elsa J.
  - Hoferkorn, Marie A.*
  - Hedeman, Ruth
  - Heinzerling, Margaret*
  - Herbert, Agnes*
  - Hughes, Katherine
  - Lohrfink, Emma*
  - Lowe, Margaret
  - McHale, Helen
  - Menton, Margaret
  - Norris, Grover*
  - O'Donnell, Eleanor
  - Reese, Ursula
  - Roche, Nanette*
  - Schoeppler, Mable
  - Stegman, Helen M.
  - Whelan, Loretta
  - Whitfield, Hester C.
- Catonsville
  - Schwartz, Edna F.*
  - Schwarts, J. Karl
- Frostburg
  - Howard, Homer*
- Reistertown
  - Meeks, Anna
  - Tipton Louise
- Sparrows Point
  - Wachter, Helen*
- Towson
  - Morrison, Helen

MASSACHUSETTS
- Andover
  - Sides, Winfield M.*
- Boston
  - Sherman, Ruth (Mrs.)*
  - Simmons, Helen*
  - Wilson, Guy M.*
- Cambridge
  - Beatley, Ralph*
  - Rule, John T.
- Grosse Pointe
  - Simmons, Cyril H.*
- Lawrence
  - Lord, Margaret*
  - Praete, Edward F.*
- Longmeadow
  - Smith, Rolland R.*

MICHIGAN
- Berrien Springs
  - Cassell, Mabel
- Detroit
  - Beck, Hildegarde*
  - Covery, Hlanche*
  - Miller, Helen R.*
  - Thiele, C. L.*
  - Tremper, Lorana*
- Kalamazoo
- Everett, John P.*

MINNESOTA
- Minneapolis
  - Brueckner, Leo J.*

MISSOURI
- Clayton
  - Rosskopf, Myron F.*

NEBRASKA
- Lincoln
  - Congdon, Allan R.*

NEW HAMPSHIRE
- Exeter
  - Adkins, Jackson B.*
- Plymouth
  - Smith, Geneva*

NEW JERSEY
- Asbury, Park
  - Lewis, Dorothy
  - Schmitt, Dorothy A.
  - Young, Charlotte
- Atlantic City
  - Brennan, Gertrude M.
  - Freed, Herbert
  - Kelly, Mrs. May J.*
  - Lidell, Burton*
  - Rhodes, Mabel V.
  - Sailor, Anna B.
  - Spencer, Mary
  - Stanburg, Bertha*
  - Whelan, Dorothy C.
- Bridgeton
  - Durst, Mrs. Kenneth
  - Gibson, Julia
  - Joslin, Vera*
- Camden
  - Lukens, Marion*
- Clifton
  - Benson, James
- Collingswood
  - Brinker, Myretta F.*
  - Fender, Ella
  - Olinger, Chester
- Dumont
  - Seigenfuse, H. M.
  - Slingland, Edward R.

* Denotes membership in the National Council of Teachers of Mathematics.

East Orange
Risinger, Hubert*
Robinson, Fannie H.*
Elizabeth
Dwyer, John E.*
Gorgeous, Florence*
Loughren, Amanda
Molloy, Edward
Fort Leo
Agatha, Sister M.
Glassboro
Baylis, Milton W.
Downer, Harlan
Outland, Maurice
Hackensack
Eckel, Emma
Hoboken
Housman, Ida E.
Jersey City
Bernier, Anita
Grossnickle, Foster E.
Hemenway, Alice*
McDermott, Thora
McMackin, Frank
McMartin, Janet C.*
Sutton, P. Helen
Kearney
Moore, Marion
Lawrenceville
Fletcher, Durell*
Mickesh, J. S.
Lindon
Hersh, Beatrice
Ramage, George
Reynolds, Elizabeth
Rose, Agnes M.*
Schott, John D.
Madison
Starkey, S. Herbert, Jr.*
Manasquan
Oakley, Chauncey
Stevely, John E.
Millville
Carter, Frances
Coombs, Elizabeth F.*
Montclair
Aubert, Eugene
Bolger, Helen Ruth
Clifford, Paul C.*
Conine, E. F.*
Fehr, Howard F.*
Hildebrandt, E. H. C.*
Macchi, John
Mallory, Virgil S.*
McLean, William
Moorestown
Carr, Wilbur E.
Mechling, W. H.
Mount Holly
Sinton, Elizabeth F.*
Newark
Ayers, N. Howard*
New Brunswich
Ely, Adele*
North Plainfield
Atkins, Fred E.*
Gunter, Earl August
Nutley
Assmus, Edward
Ocean City
Bradley, Agnes
Stauffer, Adelaide
Passaic
Stiles, May
Paterson
Daugherty, J. Dwight*
Offhouse, Chas. D.
Paulsboro
Heilman, Carl E.*
Pfleger, Emily R.
Perth Amboy
Kertes, Ferdinand*
Point Pleasant
Bridenbaugh, E. Paul*
Red Bank
Manning, Frances C.
Ridgefield
Freund, Robert B.
Riverton
Williams, Gertrude
Roselle
Messner, Madeline*
Rutherford
Young, Edna H.
South Orange
Talbot, Clinton D.*
Woodard, Mary Ann*
Summit
Shuttlesworth, Joseph G.*
Swedesboro
Stump, Sarah*
Trenton
Burdick, Emerson*
Cleary, Margaret M.*
Colleton, J. W.*
Donnelly, Mary
Harker, Warren
Jahn, Lora D.
Lowden, C. W.
Rubright, Lina
Shuster, C. N.
Stellas, Jack
Tomee, Olga
Wenzel, Albert*
Union
Zofay, Agnes*
Ventnor City
Turner, Sara B.
Wood, Annes
West Collingwood
Rosenthal, Henry
Westfield
Hewitt, Annie P.*
Rogers, Mary*
Wilson, Florence
West Orange
Walling, W. Donald

NEW YORK

Alfred
Seidlin, Joseph*
Bayport
Ormsby, Elizabeth*
Bronxville
Greene, Mary
Lennon, Roger
Brooklyn
Carlin, Grace*
Filiona, Sister Mary*
Greenberg, Etta*
Schutzman, William*
Waite, Etta A.*
Buffalo
Schuchardt, Arthur F.*
Catskill
Concannon, Mildred
Dobbs Ferry
Mattern, R. B.
Garden City
Griswold, Alice L.*
Glen Cove
Kenney, Vera*
Richardson, Ruth J.*
Great Neck
Meredith, Paul E.
Lindenhurst
Anderson, Alfred T.*
Mineola
Fields, Margaret*
Paterson
Jackson, Beatrice
New York City
Beall, Leslie
Bergstresser, Clinton*
Bowe, Mary M.*
Boynton, Holmes
Brown, Kenneth E.*
Hertzig, Morris*
Lazar, Nathan*
MacArthur, Edwin H.*
Midonick, Henrietta O.*
Mirick, Gordon R.*
Orleans, Joseph B.*
Palmer, Maritta*
Schlauch, William S.*
Sutherland, Ethel*
Northport
Kissam, Charles H.*
Oneida
Burns, Frances M.*
Oneonta
Sanford, Vera*
Rochester
Betz, William*
Taylor, H. Carlisle
Rockville Center
Bratton, Gladys
Reeve, Alice*
Tripp, Elma
Sayville
Burgie, Harriett J.*
Smith, Violet*
Southhampton
Blythe, Marjorie*
Syracuse
Carroll, I. S.*
Smigelsky, Frank D.*
Valley Stream
Henry Etta*

NORTH CAROLINA

Bures Creek
Dorsey Leonard
Greensboro
McDonald, Agnes*

OHIO

Athens
Morton, R. L.*
Cleveland
Jordan, Harry L.
Miller, A. Brown*
Columbus
Adel, Edna
Fawcett, Harold*
Gugle, Marie*
Wood, Ray G.*
Oxford
Christofferson, H. C.*
Shaker Heights
Miller, Florence B.*

PENNSYLVANIA
- Abington
  - Albright, W. H.*
  - Woodruff, J. S.*
- Bryn Mawr
  - Atkinson, Robert
  - Cosmey, Beatrice S.*
- Couderport
  - Swift, Kenneth
- East Stroudsburg
  - Bisbing, Minnie G.
  - Dimmick, Lester*
  - Flory, Ruth*
  - May, Jonas T.*
  - May, Mrs. Jonas T.
  - Young, William A.
- George School
  - Bates, Grace E.
  - Evans, Walter
  - Fletcher, Stevenson W.
  - MacNutt, Alexander
  - Shane, Joseph B.*
- Germantown
  - Breininger, Herman P.*
  - Flanders, Nancy*
- Hershey
  - Atherton, Charles R.
- Indiana
  - Mahachek, Joy*
  - Schnell, Leroy H.*
- Mansfield
  - Lloyd, S. Manford*
- Merion
  - Peters, Rachel*
- Mifflintown
  - Rearick, Alice*
- Millersville
  - Boyer, Lee*
- Overbrook
  - Fogg, P. M.*
- Philadelphia
  - Amater, Sister M.*
  - Ayer, Miriam C.*
  - Blake, Warner
  - Callen, Herbert
  - Carmel, Sister Miriam*
  - Casale, Ernest
  - Creighton, Herbert*
  - Darnell, Alice
  - Esther, Sister Mary*
  - Gage, Marguerite N.
  - Gealt, Florence
  - Goodfriend, Vera
  - Goodman, David
  - Kelson, Everett S.*
  - LeMilers, Albert
  - MacCormick, Donald E.*
  - Mercedes, Sister M.*
  - Robinson, Alexander C.*
  - Rover, Jonathan T.*
  - Rosengarten, Elizabeth*
  - Schreibman, Irene
  - Stokes, C. N.*
  - Sylvester, Sister M.
  - Todd, Lila
  - Ursula, Mother St.*
  - Wieber, Rev. Damaian B.
- Pittsburgh
  - Bortman, Edith*
  - Olds, Edwin G.*
- Wallingford
  - Butler, Edward*
- Westchester
  - Pickett, Hale*
- Westtown
  - Thomas, Agnes C.*
- York
  - Gulden, Minerva L.*

RHODE ISLAND
- Warwick
  - Daily, L. Mae*

SOUTH CAROLINA
- Rock Hill
  - Stokes, Ruth W.*

TENNESSEE
- Nashville
  - Cooke, Dennis H.
  - Wren, Frank L.*

VIRGINIA
- Charlottesville
  - Lashford, F. G., Jr.*
- Hampton
  - Perkins, Herbert A.*
- Sharon Hill
  - Long, Ella*

WASHINGTON
- Bellingham
  - Bond, E. A.*

WISCONSIN
- Racine
  - Potter, Mary A.

ATTENDANCE BY STATES

States	*Members*	*Non-M.*	*Total*
Col.	1	0	1
Conn.	5	1	6
Del.	3	0	3
D. C.	8	0	8
Fla.	1	0	1
Ill.	7	0	7
Ind.	1	1	2
Ia.	2	1	3
La.	2	0	2
Md.	9	21	30
Mass.	9	1	10
Mich.	6	1	7
Minn.	1	0	1
Miss.	1	0	1
Nebr.	1	0	1
N. H.	2	0	2
N. J.	46	63	109
N. Y.	38	9	47
N. Car.	1	1	2
Ohio	7	2	9
Penn.	39	19	58
R. I.	1	0	1
S. Car.	1	0	1
Tenn.	1	1	2
Va.	3	0	3
Wash.	1	0	1
Wis.	1	0	1
Canada	1	0	1
TOTAL	199	121	320

National Council of Teachers of Mathematics Seventh Summer Meeting with the N.E.A.*

June 30, July 1, 2, and 3, 1941

Headquarters: Vendome Hotel

General Theme: What Lies Ahead for Mathematics in Our Schools?

Program

Monday, June 30, 1941, 3:15 P. M.

Joint Session with the Department of Secondary Teachers

Presiding: Miss Mary Potter, President of National Council of Teachers of Mathematics

1. Using Multi-Sensory Aids for Enriching Mathematical Instruction—E. H. C. Hildebrandt, State Teachers College, Montclair, N. J.
2. The Future of Evaluation in Secondary Mathematics—Joseph B. Orleans, George Washington High School, New York, N. Y.
3. Trends in Radio Instruction in Mathematics—A. Brown Miller, City Schools, Cleveland, Ohio
4. Discussion

Tuesday, July 1, 1941

Presiding, Dorothy S. Wheeler, Bulkeley High School, Hartford, Conn.

12:00 Discussion Luncheon (Vendome Hotel)

It is most important to make luncheon reservations in advance. Send your reservations, indicating first and second choice of tables, to Mr. Harold B. Garland, High School of Commerce, Boston, Mass.

Tables — Leaders and Topics.

1. E. H. C. Hildebrandt: Inexpensive Materials and Models
2. R. L. Morton: Can Arithmetic Be Taught Adequately Through "Activity" Education?
3. L. E. Boyer: The Mathematics of the Traffiscope
4. Ralph Beatley: Getting the Most out of Demonstrative Geometry
5. Ruth W. Stokes: General Effect of the Defense Program on Mathematics in the Secondary School
6. W. D. Reeve: The Next Move in Mathematics
7. Guy M. Wilson: The Why and How of Functional Problem Units in Arithmetic
8. Nathan Lazar: Which Logical Concepts and Laws Should Be Taught in Secondary Mathematics?
9. Mrs. A. Brown Miller: The Mathematics Classroom
10. A. Brown Miller: The Radio as a Means of Mathematical Instruction
11. Wm. Fitch Cheney, Jr.: The Problems Presented by Divergent Objectives in Teaching Trigonometry
12. A. A. Bennett: Should the High School Geometry Course Seek to Apply Logic to Daily Affairs?
13. R. R. Smith: Gestalt and the Teaching of Mathematics
14. Joseph B. Orleans: The Textbook *versus* the Blackboard in the Teaching of Mathematics
15. Foster E. Grossnickle: The Training Program in Arithmetic for the Prospective Teacher
16. W. Betz: The Coming Three Track Program in Secondary Mathematics
17. Kenneth G. Fuller: What are the Contributions of Mathematics to Consumer Education?

* Visitors welcome. No charge. Members and visitors will please register.

2:00–4:00

Section I—What Lies Ahead For Arithmetic?

Presiding, Foster E. Grossnickle, New Jersey State Teachers College, Jersey City, N. J.

1. Arithmetic in General Education—Highlights from the Yearbook—R. L. Morton, Ohio University, Athens, Ohio
2. How to Capitalize Children's Experiences in Learning Arithmetic—Mark L. Shibles, Asst. Superintendent of Schools, Belmont, Mass.
3. The Contribution of Arithmetic to a Liberal Education—B. R. Buckingham, Editor, Ginn and Co., Boston, Mass.
4. Discussion

Section II—What Lies Ahead for Junior High School Mathematics?

Presiding: Paul E. Werner, City Schools, Greenwich, Conn.

1. Recent Trends in Revising the Curricula in Mathematics for Junior High Schools in New York City—Mesmin Arenwald, Olinville Junior High School, New York, N. Y.
2. Vitalizing Junior High School Mathematics for Non-College Students—Mary C. Rogers, Roosevelt Junior High School, Westfield, N. J.
3. "Come Over Into Macedonia"—Wm. G. Shute, The Choate School, Wallingford, Conn.
4. Discussion

Section III—What Lies Ahead for Senior High School Mathematics?

Presiding: Martha Hildebrandt, Proviso Township High School, Maywood, Ill.

1. Don't Forget the Good Student—E. P. Northrop, Hotchkiss School, Lakeville, Conn.
2. A New Demonstrative Geometry from a High School Teacher's Point of View—Donald G. Enoch, Newton High School, Newtonville, Mass.
3. The Role of Relational Thinking in Secondary Mathematics—F. Lynwood Wren, George Peabody College for Teachers, Nashville, Tenn.
4. Discussion.

4:00–5:30

Demonstrations of Multi-Sensory Aids

Presiding: E. H. C. Hildebrandt, State Teachers College, Montclair, N. J.

4:00 Foundations of Reasoning

Recording of a Plane Geometry Demonstration Lesson by V. S. Mallory, New Jersey State Teachers College, Montclair, N. J.

4:15 Mathematical Films. Junior high school topics prepared by Dominick Montelbano, Public School No. 109, Brooklyn, N. Y.

4:30 A Mathematical Radio Program.

Recording of a recent broadcast.

4:45 An Experiment in Sound and Sight.

Joseph Hilsenrath, Townsend Harris High School, New York, N. Y.

5:00 Polaroid Three Dimensional Pictures in Solid Geometry.

5:10 British Mathematical Films.

Headquarters and Rates

The Vendome Hotel is located on Commonwealth Avenue at Dartmouth Street near Copley Square not far from the Hotel Statler which is the headquarters for the N.E.A. The rates at the Vendome are as follows:

Single rooms with private bath $3 and up.

Double rooms with private bath (Double beds) $4 and up; (with twin beds) $5 and up.

Living room, bedroom, and bath (2 persons) $8 and up.

◆ THE ART OF TEACHING ◆

Junior High School Mathematics Clubs

By RUTH PERSON
Superior, Wisconsin

VERY little was done with junior high school mathematics club work prior to 1930 but, in the last decade, this project has been introduced to many classroom groups of young persons of junior high school age. Much enthusiasm for the work entailed has been shown by the pupils concerned and much benefit has been reaped by those participating actively in this type of school club work. For greatest success the work of each particular junior high school mathematics club must be planned to meet the general interest of the pupils concerned and attuned to their average ability. Suggestion for the organization of such a club may come logically from the mathematics teacher and a proper presentation of the project to the class can produce a club of self-chosen members enthusiastically awaiting the enjoyment of many mathematical treats.

In introducing the idea of a junior high school mathematics club to any group, a number of mathematical recreations should be proposed to illustrate the possible work of the club. Simple problems are best for this; the following are good instances of one type of problem:

1. Which is correct to say, four and seven are twelve, or four and seven is twelve?
2. A man, having a fox, a goose, and a bag of corn, is anxious to cross a stream. He can take but one at a time but the fox will kill the goose and the goose will eat the corn if they are left together. How can he get them safely across?

Pupils should be made to understand that having fun is to be the chief aim of the club; only those pupils choosing to join of their own accord should be accepted for club membership. However, the fun to be had from solving puzzles, working magic squares, and the like should be illustrated in such manner that each pupil concerned may well be intrigued by the entertainment the mathematics club has to offer.

The chapter on "Mathematical Recreations" in Jones's *Mathematical Wrinkles* will supply basic ideas for the building of a year's program for a junior high school mathematics club. Some topics of value for such a program are: magic squares and triangles, geometric designs, number oddities, paper folding, and mathematical recreations or puzzles. Other topics may well be chosen from stories in either *Number Stories of Long Ago* or *The Wonderful Wonders of One-Two-Three*, a mathematical play from THE MATHEMATICS TEACHER, problems from Sunday papers, and the like. One feature very popular usually with any club group after mid-year or later is the "spell down" on puzzles and questions learned in club thus far. Members seem generally to be intensely interested in this type of program and clamor for more of similar nature.

The last club meeting of the year may well be a dinner meeting which can be used to heighten the interest in the fun-possibilities of mathematics club work. Members of another junior high school club, or of the in-coming sixth grade group of children if that is feasible, may be invited as guests. The plan easily can be that each club member may assume the responsibility for a guest and prepare the necessary invitation. Too, each member could prepare two place cards, one for his guest and one for himself. These place cards of colored poster paper may be cut in various

shapes to suit the fancy of the cutter. Suggested shapes are triangles, squares, rectangles, circles, semi-circles, hexagons, octagons, five-pointed stars, and trapezoids. For each person's table mat a geometric design may be used. At one junior high school mathematics club party a huge snowflake served this purpose. Cut from a nine-inch square of white paper, the snowflake was pasted on a dull gray piece of poster paper. For entertainment twelve puzzles were chosen; these were written on three by four-inch cards and thus made accessible to guests and club members alike. This dinner meeting type of party can be made to serve a number of ends, not the least of which could be the creating of more interest in the mathematics club and its fun.

The club sponsor (mathematics teacher) needs to be ready at all times with interesting things for club members to do. To meet this responsibility a growing file of mathematical recreations is almost a necessity and such a file will be found a decided convenience. Each recreation may be written on its separate card with the recreation on the one side and the solution on the other. As soon as the quantity of material in the file becomes a bit extensive, an appropriate index and needed cross references may be devised in order that everything in the file may be readily located. For this file only material written in the vocabulary of the junior high school pupil should be chosen; in some instances material, otherwise desirable, may be remade as to vocabulary so that it is not over the heads of members of the junior high school mathematics club group. Although mathematics club materials are more handily available in the literature and the library than they were, say, five years ago, each club sponsor will find it decidedly convenient to continue to cull materials from a variety of sources in order to build up an individual and personal supply which may be reclassified, from time to time, as the needs of the current group dictate. Vigilance here, as elsewhere, rewards itself.

The knowledge of mathematics will always need to be enriched and the junior high school mathematics club offers a logical place in which to add to this enrichment. The part mathematics has played in civilization, and is still playing in every day life, should be taught in junior high school; programs planned for the mathematics club may well emphasize this feature. All students should be shown the fun to be found in the subject of mathematics as this type of knowledge will do much to broaden their vision. Too, once pupils have become right enthusiastic about mathematics fun, they, more than likely, are tending to acquire a fun-sense which can be a distinct safeguard against falling in with less desirable types of fun. If this is true, the club sponsor reaps reward in the knowledge that the work done for the junior high school mathematics club has made a distinct contribution toward higher-plane community life.

Material for junior high school mathematics club work may be found in school magazines of more recent years as well as in the following books:

JONES, SAMUEL I., *Mathematical Wrinkles.* Samuel I. Jones Publishing Company, Nashville, 1930. viii+328 p.

ROW, T. SUNDARA, *Geometric Exercises in Paper Folding.* Open Court Publishing Company, 1917. xiv+148 p. (out of print.

SMITH, DAVID E., *Number Stories of Long Ago.* Ginn and Company, Chicago, 1919. viii+136+14 p.

———. *The Wonderful Wonders of One-Two-Three.* McFarlane-Wade-McFarlane, New York, 1937. 48 p.

———. *Numbers and Numerals.* Bureau of Publications, Teachers College, Columbia University, New York, Contributions of Mathematics to Civilization No. 1, 1937. x+52 p.

SYKE, MABEL, *A Source Book of Problems for Geometry Based upon Industrial Design and Architectural Ornament.* Allyn and Bacon, Boston, 1912. viii+372 p.

EDITORIALS

Mathematics in A Defense Program

THIS ISSUE is devoted mostly to a consideration of *Mathematics in a Defense Program.* As stated elsewhere in this issue the program of the recent annual meeting of the National Council of Teachers of Mathematics at Atlantic City, N. J. was built around this general theme. Some of the material presented at that meeting is included in this issue as well as other material. More material on that general theme or some of the detailed aspects will appear in later issues of THE MATHEMATICS TEACHER.

This does not mean that we believe that the only defense is a military one. On the contrary, the best and surest way to perfect a lasting defense for democracy in this country is to develop well educated citizens. THE MATHEMATICS TEACHER believes that the right kind of mathematical education is an integral part of the training of every citizen whether he is to take any part in the military naval, or technical aspects of the defense program. If a person is to have an active part in the present defense program in the army, navy, or some technical department of the defense program it is all the more important that he should have had a certain amount of mathematical education.

All of this shows how in peace time we cannot reduce the amount of actual mathematical training of each boy and girl, particularly the boy, to the narrowest kind of minimum because we never know at any time what demands the future is going to make on our citizens. For this reason and for many others the leaders in general education to say nothing of the leaders in mathematical education should be careful about reducing the amount of required mathematics to too small a minimum. In this connection all of our readers should try to read Walter Lippmann's recent article in the Spring 1941 issue of *The American Scholar.*

W. D. R.

THE FIFTEENTH YEARBOOK of the National Council of Teachers of Mathematics, on "The Place of Mathematics in Secondary Education," was recently voted one of the 60 most outstanding educational books of 1940. This list was compiled for the American Library Association and the National Education Association by the Education Department of the Enoch Pratt Free Library of Baltimore, Maryland.

This in itself is honor enough, because the choice was made on the basis of educational content. However, the Council can feel unusually proud of this publication, because since this list was made out, the Fifteenth Yearbook has also been chosen by the American Institute of Graphic Arts as one of the 60 most outstanding textbooks "of the highest artistic and technical excellence, selected on the basis of physical attractiveness, suitability to teaching purposes, and the success with which the designer has solved the various problems imposed."

This latter selection is a tribute to the Bureau of Publications, Teachers College, Columbia University, which has printed all of the yearbooks since the first. If you have not yet secured a copy of this important publication, you should do so before the supply is exhausted.

W. D. R.

◆ IN OTHER PERIODICALS ◆

By NATHAN LAZAR
The Bronx High School of Science, New York City

The American Mathematical Monthly

February 1941, Vol. 48, No. 2.

1. Langer, R. E., "Alexandria—Shrine of Mathematics," pp. 109–125.
2. Georges, J. S. "Integrated versus Traditional Mathematics," pp. 126–131.
3. Fertig, R. A., "A Substitute for the Law of Tangents," p. 132.
4. Cell, J. W., "Solid Angles," pp. 136–138.

National Mathematics Magazine

February 1941, Vol. 15, No. 5.

1. Rutt, N. E., "Truth and Hard Times," p. 218.
2. Hall, Newman A., "The Solution of the Trinomial Equation in Infinite Series by the Method of Iteration," pp. 219–229.
3. Goormatghtigh, R., "A Generalization of Euler's Relations in the Triangle," pp. 230–231.
4. Shover, Grace, "On Roots of Unity," pp. 232–233.
5. Miller, G. A., "A Third Lesson in the History of Mathematics," pp. 234–244.
6. Finkel, Benjamin F., "The History of American Mathematical Journals," (continued) pp. 245–247.
7. Gunder, Dwight F., "Coordinating the Teaching of Mathematics in High Schools and Colleges," pp. 248–250.
8. Camp, Chester C. "Grades in Freshman Algebra as Indicative of Later Success in Engineering Mathematics Courses," pp. 251–253.

School Science and Mathematics

March, 1941, Vol. 41, No. 3.

1. Reid, Noma Pearl, "Archimedes, A. Mathematical Genius," pp. 211–219.
   A play developed as a creative activity in a mathematics class.
2. Kinney, J. M., "New Proofs of the Theorems of Pythagoras," pp. 249–254.
3. Loomis, Zoe C., "Elisha S. Loomis, 1852–1940, A Teacher," p. 255.
4. Friedman B., "Teaching Mathematical Induction," pp. 279–280.

Miscellaneous

1. Barnett, O. E., and Barnett, G. T., "Number Seatwork," *Grade Teacher*, 58: 23, February 1941.
2. Bushell, F. "Wanted—A New Mathematical Syllabus," *Journal of Education* (London), 72: 521–522, December, 1940.
3. Buswell, G. T., "New Material for Social Arithmetic," *Elementary School Journal*, 41: 328–330, January 1941.
4. Di Mauro, J., "Banking Activity for Middle Grades," *Instructor*, 60: 16, January, 1941.
5. Dwyer, G. W., "Arithmetic Test on Buying," *Instructor*, 50: 23, February 1941.
6. Engle, F. A., "Arithmetics Contribution to a Child's Training," *Kentucky School Journal*, 19: 26–27, January, 1941.
7. Grossnickle, F. E., "Comparison of Achievement of Pupils Who Are Good and Poor in Learning Division with a Two-figure Divisor," *Journal of Educational Research*, 34: 346–351, January, 1941.
8. Hartung, M. L., "Promoting Ability to Read for Different Purposes in Secondary Schools and Colleges Mathematics," *Proceedings of the Conference on Reading Held at the University of Chicago* (W. S. Gray, editor), pp. 138–142.
9. Held, O. C., "Mathematics Test as a Chemistry Placement Test," *Journal of Chemical Education*, 18: 17, January, 1941.
10. Horn, A., "Sine, Secant, Tangent," *High Points*, 22: 50–51, December, 1940.
11. Judd, W. J., "Teaching English Through Arithmetic," *School* (Elementary Edition), 29: 478–480, January, 1941.
12. "Mathematics for Aircraft Crews," *Times Educational Supplement* (London), 1336: 489, December 7, 1940.
13. McKnight, J. I. R., "Teacher's Dilemma: Discovering New Ways of Teaching Old Material," *School* (Secondary Edition), 29: 398–401, January, 1941.
14. Meek, R. R., and Zechiel, A. N., "Functional Mathematics Teaching," *Educational Research Bulletin*, 19: 479–482, November 20, 1940.
15. Miller, G. A., "Arithmetic and Algebra," *School and Society*, 53: 84, January 18, 1941.
16. Mills, J. S., "Number Games," *The Grade Teacher*, 58: 324, February, 1941.
17. Nadler, M., "Why more Failures in Mathematics?" *High Points*, 23: 65–67, January, 1941.
18. Peak, P., "Recognizing Number Value," *Nebraska Educational Journal*, 20: 331, November, 1940.
19. Risden, G. A., "Learning for Remembering," *Educational Method*, 20: 65–69, November, 1940.
20. Root, D. O., "Paving The Way for Algebra," *Journal of Education*, 124: 9, January, 1941.

21. Shelton, H. S., "Wanted—A New Mathematical Syllabus," *Journal of Education* (London), 72: 450–451, October, 1940.
22. Smith, G. R., "New Ontario Textbooks in Mathematics," *School* (Elementary Edition) 29: 389–392, January, 1941.
23. Smith, H. L., and Eaton, M. T., "Teaching of Arithmetic to Low-ability Students in the Elementary Schools," *Bulletin of The School of Education, Indiana University*, 16: 5–127, November, 1940.
24. Trimble, H. C., "Types of Growth That May Be Stimulated Through Reading in the Secondary School," SCHOOL SCIENCE AND MATHEMATICS, *Proceedings of the Conference on Reading Held at the University of Chicago* (edited by W. S. Gray), pp. 36–41.
25. Waite, E. A., "Place of Remedial Reading in the Teaching of Mathematics," *High Points*, 23: 20–25, January, 1941.
26. Zwicker, A., "Arithmetic Test," *Instructor*, 50: 24, January, 1941.

NEWS NOTES

National Council of Teachers of Mathematics Affiliated Clubs 1940–41

Alabama

1. Department of Mathematics of the Alabama Education Association.
   President—Miss Adele M. Kirk, Sidney Lanier High School, Montgomery, Ala.
   Vice-President—Wm. A. Martin, Auburn, Ala.
   Secretary-Treasurer—Mrs. Jessie Atchison, Tuscaloosa High School, Tuscaloosa, Ala.

Colorado

1. Eastern Division, Mathematics Section of Colorado Educational Association.
   President—Miss Alfhild Alenius, South High School, Denver, Colo.
   Vice-President—Dr. A. E. Mallory, Colorado State College of Education, Greeley Colo.
   Secretary-Treasurer—Mr. Valworth Plumb, Gove Junior High School, Denver, Colo.
2. Southern Division, Mathematics Section of Colorado Education Association.
3. Denver Mathematics Discussion Club.
   Chairman—H. W. Charlesworth, East High School, Denver, Colo.
   Secretary—Miss Isabel Marsh, Gove Junior High School, Denver, Colo. Number of members—About 18.

Illinois

1. Mathematics Organization of the Southwestern Division of the Illinois Education Association.
   President—Miss Christine Fischer, Township High School, Belleville, Ill.
   Vice-President—Mr. H. E. Fletcher, Community High School, Granite City, Ill.
   Secretary-Treasurer—Miss Orpha Holmes, Community High School, New Athens, Ill.
2. Men's Mathematics Club, Chicago and Metropolitan Area.
   President—Mr. H. Gutekunst, Batavia High School, Batavia, Ill.
   Secretary-Treasurer—Mr. C. E. Jenkins, Foreman High School, Chicago, Ill.
   Recording Secretary—Mr. S. F. Bibb, Illinois Institute of Technology, Chicago, Ill.
3. Women's Mathematics Club of Chicago, and Vicinity.
   President—Miss Clara Haertel, Englewood, Ill.
   Vice-President—Miss Mary Jane Hartman, Oak Park, Ill.
   Secretary—Miss Mildred Taylor, Fenger, Ill.
   Treasurer—Miss Ducy Mainbecker, Steinmetz, Ill.
4. Southern Illinois Council of Mathematics Teachers.
   Chairman—Mr. Raymond Huck, Centralia, Ill.
   Vice-Chairman—Mr. John Moss, Christopher, Ill.
   Secretary—Miss Etna Morrison, Benton, Ill.
   Treasurer—Mr. Fred Thalgott, Benton, Ill.

Indiana

1. Mathematics Section of the Indiana State Teachers Association.
   President—Frank A. Ross, Rockport High School, Rockport, Ind.
   Vice-president—Fern Hodson, Newcastle High School, Newcastle, Ind.
   Secretary—Miriam King, Broad Ripple High School, Indianapolis, Ind.
2. Indianapolis Mathematics Club.
   President—Mrs. Mildred Loew, Thomas Carr Howe High School, Indianapolis, Ind.
   Vice-president—Mr. Frank Parker, Crispus Attucks High School, Indianapolis, Ind.
   Secretary-Treasurer—Miss Clara Rodebaugh, School #58, Indianapolis, Ind.

Iowa

1. Mathematics Section of the Iowa State Teachers Association.
   President—George H. Nickle, Keokuk, Iowa.
   Vice-President—Katharine Young, Waterloo, Iowa.
   Secretary—Dr. Ruth Lane, State University of Iowa, Iowa City, Iowa.
2. Mathematics Section of the Southeast Division of the Iowa State Teachers Association.
   Chairman—Miss Marie O. Rearick, Davenport Senior High School, Davenport, Iowa.

Kansas

1. Wichita Mathematics Association.
   President—Miss Lorena E. Cassidy, East High School, Wichita, Kan.
   Vice-president—Miss Clara Peterson, Roosevelt Intermediate, Wichita, Kan.
   Secretary—Miss Pearl M. Miltner, Hamilton Intermediate, Wichita, Kan.
   Treasurer—Miss Nell Leichhardt, Horace Mann Intermediate, Wichita, Kan.

Kentucky

1. Kentucky Council of Mathematics Teachers.
   President—Miss M. Cottell Gregory, Louisville Girls' High School, Louisville, Ky.
   Secretary-Treasurer—Miss Elizabeth Strayhorn, Western Kentucky State Teachers College, Bowling Green, Ky.

Louisiana-Mississippi Branch of the National Council of Teachers of Mathematics.
President—Houston T. Karnes, Louisiana State University, University, La.
Secretary—Mrs. E. W. Northcross, Tupelo, Miss.

Michigan

1. Detroit Mathematics Club.
President—Miss Blanche Covey, Mackenzie High School, Detroit, Mich.
Vice-president—Mr. Duncan Pirie, Jefferson Intermediate, Detroit, Mich.
Secretary—Miss Margaret Hanley, Barbour Intermediate, Detroit, Mich.
Treasurer—Mr. Robert Lankton, Northeastern, Detroit, Mich.

Nebraska

1. Alpha Mu Omega, Peru, Nebraska.
President—Ross Russell. (First semester)
Vice-president—Frank Larson. (First semester)
Secretary—Edith Dilley. (First semester)
Treasurer—Phyllis Dammast. (First semester)
2. Nebraska Section of the National Council of Teachers of Mathematics.
President—Milton Beckmann, Kearney, Neb.
Vice-president—Lena Meyer, Kimball, Neb.
Secretary—Leo. R. Taylor, Norfolk, Neb.
Treasurer—Ruth Thompson, Minden, Neb.

New England

1. The Association of Teachers of Mathematics in New England. Membership about 500.

New York

1. Section 19, Secondary Mathematics of the New York Society for Experimental Study of Education.
President—Dr. John R. Clark, Lincoln School, Teachers College, Columbia University, New York, N. Y.
Vice-president—Dr. W. S. Schlauch, New York University, New York, N. Y.
Secretary-Treasurer—Dr. Nathan Lazar, Bronx High School of Science, New York, N. Y.
2. David Eugene Smith Club of New York City.
President—Kenneth Brown, Teachers College, Columbia University, New York, N. Y.
Vice-president—John Alman, Lincoln School, New York, N. Y.
Secretary-Treasurer—Marion Dwinell.
3. Tri-County Mathematics Club.
President—Mary E. Adams, Hornell, N. Y.
Vice-president—Everett W. Smethurst, Bath, N. Y.
Secretary-Treasurer—Charles H. Pocock, Wellsville, N. Y.
4. Nassau County Mathematics Teachers Association.
(Not affiliated, but 50% of members are also members of N.C.T.M.)
President—Miss Elma Tripp, Rockville Centre, N. Y.
Vice-president—Miss Alice Reeve, Rockville Centre, N. Y.
Secretary—Miss Richardson, Glen Cove, N. Y.

North Dakota

1. Mathematics Section of North Dakota Education Association.
Chairman—Ruby Grimes, State College, Fargo, N. D.
Vice-Chairman—Marguerite Craig, Minot Sr. H. S., Minot, N. D.
Secretary—N. B. Knapp, Grand Forks Sr. H. S., Grand Forks, N. D.

Ohio

1. The Mathematics Club of Greater Cincinnati.
President—Mildred Keiffer, Walnut Hills H. S., Cincinnati, Ohio.
2. Cleveland Teachers Mathematics Club.
President—Mr. H. L. Jordan.
Vice-president—Miss Dorothy Robinson.
Secretary—Mrs. Charlotte Mapes.
Treasurer—Mr. Vincent Benander.

Oregon

1. Portland Council of the Teachers of Mathematics.
President—Dana Small, Portland, Ore.
Vice-president—Minnie Ambler, Portland, Ore.
Secretary-Treasurer—John Phillips, Milwaukie, Ore.
Corresponding Secretary—Myrtle Groshong Portland, Ore.

Pennsylvania

1. Mathematics Association of Western Pennsylvania.
Chairman—Dr. K. H. Stahl, California T. C., California, Pa.
Vice-chairman—Dr. W. J. Wagner, Pittsburgh, Pa.
Secretary-Treasurer—Miss Ida M. Price, Pittsburgh, Pa.

West Virginia

1. Huntington Council of Mathematics Teachers.
President—Mr. L. B. Welty, Milton High School, Milton, W. Va.
Secretary—Mrs. Irene C. Evans, Marshall Laboratory H. S., Huntington, W. Va.

The Louisiana-Mississippi Branch of the National Council of Teachers of Mathematics met jointly with the Louisiana-Mississippi Section of the Mathematical Association of America at Tulane University, New Orleans, Louisiana, on March 7 and 8, with Tulane University as host.

On Friday, March 7, at 2 P.M., an address of welcome was given by Dr. H. E. Buchanan of Tulane University.

The following were appointed to serve on committees as indicated:

Member to act with Mathematical Association on place of meeting for 1943:

Miss Janet McDonald, Hinds Junior College.

Committee on nominations:

W. H. Bradford
T. A. Bickerstaff
Miss Elizabeth Freas
Mrs. E. W. Northcross
Miss Janet McDonald (substituted for Mr. Bickerstaff)

Member to act with Mathematical Association on resolutions:

P. C. Scott, Louisiana State University.

A banquet was held on March 7 at 7:30 P.M. in the Student Center with Dr. G. F. Cramer of Tulane University as toastmaster. An address of welcome was given by Professor R. P. McCutcheon, Dean of the Graduate School, Tulane University. A response to the welcome was given for the Council by Miss Virginia Felder, Copiah-Lincoln Junior College, Wesson, Mississippi. Professor E. J. McShane of the University of Virginia made an address on the subject: Research and Teaching.

The National Council met at 8 A.M. Saturday, March 8, in Room 42 of Gibson Hall with Mr. H. T. Karnes of Louisiana State University, Chairman, presiding.

The following program was given:

1. A Philosophy of Teaching for Mathematics Teachers
   Miss Virginia Felder, Copiah-Lincoln Junior College
2. Some Aspects of High School Curricula in Mathematics
   H. F. Schroeder, Louisiana Polytechnic Institute
3. The Correlation of Mathematics and Science in the Secondary School
   E. C. Thayer, Francis T. Nicholls High School, New Orleans
4. The Mathematics Teacher Looks Two Ways
   Miss Lurline Stewart, Tylertown High School, Tylertown, Mississippi.
5. The Cultural Influence of High School Mathematics in Life
   Mrs. Lars Christensen, Louisiana State University
6. Some Aspects of the Mathematics Situation in Louisiana
   G. E. Jones, Louisiana Polytechnic Institute

Mr. Dewey S. Dearman, Mississippi Southern College, and Miss Jessie May Hoag, Jennings High School, Jennings, Louisiana, who represent their respective states in relation to the National Council, made reports of their work, at the request of the Chairman. It was urged that efforts be made to secure an increase in membership.

A motion was made by Mr. W. H. Bradford, seconded by Mr. Schroeder, and amended by Mr. Cole, that the office of Recorder be created, said Recorder to be elected for a period of five years, subject to continuation in office if desirable. The Recorder shall maintain a closer and better contact with the head office of the National Council; he shall keep permanent files of the work; he shall engage himself with far-reaching and long-time plans for building up the Branch of the Council.

A motion was made that a Vice-Chairman be included in the list of nominations regularly, said Vice-Chairman to be elected from the town or city in which the next meeting will be held, to work with the Vice-Chairman of the Association on arrangements, advertising, etc. The suggestion that the Vice-Chairman be a high school teacher was incorporated in the motion, to aid in drawing high school teachers into the activities of the Council.

The report of the nominating committee is as follows:

Chairman: Dewey S. Dearman
Mississippi Southern College
Hattiesburg, Mississippi

Vice-Chairman: Miss Pearl Swann
Central High School
Jackson, Mississippi

Secretary: Miss Jessie May Hoag
Jennings High School
Jennings, Louisiana

Recorder: Houston T. Karnes
Louisiana State University
University, Louisiana

A motion was made that two Council members be named to serve with representatives from the Association and the Louisiana College Conference Mathematics Section, to act with them in submitting suggestions or recommendations to the Louisiana State Department of Education. Mr. E. C. Thayer and Miss Jessie May Hoag were appointed.

In the Association meeting, the place of meeting for 1943 was announced to be at Ruston, Louisiana, with Louisiana Polytechnic Institute as host.

Adjournment.

JOSEPHINE HARWOOD NORTHCROSS
Secretary

The twenty-seventh annual meeting of the Kansas Section of the Mathematical Association of America and the thirty-seventh annual meeting of the Kansas Association of Teachers of Mathematics was held at the Kansas State College at Manhattan on April 4 and 5, 1941.

PROGRAM

Friday, April 4

8:00 College Auditorium

SYMPOSIUM: *Science and National Preparedness*

Mathematics and National Preparedness, Professor William L. Hart, University of Minnesota, Minneapolis.

Engineering and National Preparedness, Dean Alexander S. Langsdorf, Washington University, St. Louis

Saturday, April 5

Morning Session, Room W-101, Willard Hall

8:30 A.M. Registration desk opens outside Room W-101

9:00 A.M. Joint Session, K. A. T. M. and Kansas Section of M. A. A. G. Baley Price, *Presiding*

Mathematics and the Junior Colleges (30 minutes), Dean Helen Moore, Kansas State College, Manhattan.

Modified High School Algebra (30 minutes), R. W. Babcock, Kansas State College, Manhattan.

The Council, Mary A. Potter, President National Council Teachers of Mathematics

Greetings—William L. Hart

Business Meeting, Mrs. Adelle Davis, *Presiding*

12:00 M. County Club

Luncheon and Social Hour

Afternoon Session

K. A. T. M.

1:30 P.M. Room X-109 Mathematics Hall, Mrs. Adelle Davis, *Presiding*

In Defense of Donald the Dull Mary A. Potter, Racine, Wisconsin

M. A. A.

1:30 p.m. Room X-101 Mathematics Hall, G. Baley Price, *Presiding*

The Rôle of Mathematics in Airplane Design and Navigation (20 minutes), R. G. Smith, Kansas State Teachers College, Pittsburg

Curricular Suggestions Related to the National Emergency (20 minutes), W. L. Hart, University of Minnesota, Minneapolis

Applications of Statistics in Agriculture (20 minutes), H. C. Fryer, Kansas State College, Manhattan

Report of Committee on Placement Test (30 minutes)

Report of the Nebraska-Kansas-Missouri Representative on the Board of Governors (20 minutes), O. J. Peterson, Kansas State Teachers College, Emporia

Business Meeting

The greatest concentration of courses in the forthcoming summer quarter at The University of Chicago is found in the department of education, with its faculty of 40 professors conducting a total of 71 courses.

The department will present six workshops covering all levels of education. Originated in 1936 by Dr. Ralph W. Tyler, chairman of the department, the workshop method enables teachers to plan courses and develop methods of teaching in cooperation with fellow teachers under the guidance of curriculum and examination experts. The workshops will include elementary, secondary, and general education, and sessions on child development, youth, and the arts and crafts. The University's elementary, high school, and junior college demonstration classes will be closely related to workshops at these levels. Complementing these will be workshops in the field of home economics, and community nursing and public health, offered by the department of home economics, and a workshop for college librarians. In addition the University of Chicago is sponsoring workshops for teachers and administrators in southwestern Michigan in cooperation with the W. K. Kellogg Foundation.

Further spotlighting educational problems, the department of education will maintain demonstration schools of children from pre-school age to junior college level. They will receive instruction in languages, arts, sciences, and health, affording an opportunity for summer quarter students to see and discuss the most recent developments in educational theory and practice. Among the features to be presented during the summer quarter are cooperative planning of high school work by teachers and pupils, initial experiences in primary reading, and counseling and guidance procedures.

Teachers of the biological sciences in high schools and junior colleges will meet June 30 to July 2, and high school teachers of the social sciences will gather July 1–3 in summer quarter conferences.

Administrative officers of higher institutions will meet in the fifteenth annual institute of that group from July 9–11. In line with the University's fiftieth anniversary theme "New Frontiers in Education and Research," the administrative officers will discuss "New Frontiers in Collegiate Instruction." In addition the tenth annual Conference of Administrative Officers of Public and Private Schools, July 21–25, and the fourth annual Conference on Reading Problems for Administrative Officers and Teachers, July 25–28, will meet on the Quadrangles during the summer quarter.

The Annual Joint Luncheon and panels of The Mathematics Chairmen's Association and The Association of Teachers of Mathematics of New York City was held at The Astor Hotel on March 22, 1941.

Panel Discussions

10:00 A.M. to 12 noon

Panel I. Proposed Modern Treatment of Certain Mathematical Concepts.

Art Nouveau Hall—8th Floor

Chairman. Mr. Julius H. Hlavaty, Bronx High School of Science.

a. The Validity of the Traditional Treatment of Indirect Proof. Dr. Nathan Lazar, Bronx High School of Science.

b. Operation. Mr. Charles Salkind, Samuel J. Tilden High School.

Panel II. Techniques, Algorithms and Other Classroom Devices.

South Garden—10th Floor

Chairman: Dr. Ellis Johnson, Erasmus High Hall School.

a. Applying the Calculus Unit to Physics.

Mr. Maurice Levine, Manual Training High School.

b. Algorithms for Some Types of Verbal Problems. Mr. Harry Kuris, Franklin K. Lane High School.

c. The Abacus and Digit Problems. Mr. Herman Karnow, Franklin K. Lane High School.

d. The Use of the Exponential Form in Logarithmic Computation. Mr. Thomas Munro, High School of Commerce.

e. A Sequence in Teaching Logarithms. Mrs. Irene Finkel, Haaren High School.

f. The Use of Models in Trigonometry. Mr. Harold Shimberg, James Monroe High School.

g. Some Functional Devices. Mr. Barnet Rich, High School of Music and Art.

h. Models and Visual Aids (Models will be displayed). Mr. Benjamin Taplitz, Technical Supervisor of Objective Teaching Materials and Techniques, Board of Education.

Panel III. Problems in Teaching Mathematics in the Junior High School.

Chairman: Mrs. Lorraine W. Addelston, J. H. S. 159, Manhattan.

College Hall—8th Floor

a. Mathematics Below the 7A. Mrs. Lenore Flanagan, J. H. S. 19, The Bronx.

b. Homework—A Burden or a Joy? Miss Grace Carlin, J. H. S. 128, Brooklyn.

c. An Introductory Lesson in Percentage. Mrs. Ruth Laicher, J. H. S. 64, Brooklyn.

d. Visual Aids. Professor E. Hildebrandt, Montclair State Teachers College.

Luncheon Program

Mathematics at the Crossroads, by William Betz.

The annual meeting of the Alabama Branch of The National Council of Teachers of Mathematics was held in Birmingham on Friday, March 28, 1941. The main address was given by Dr. F. L. Wren of Peabody College on "The Role of Relational Thinking in Mathematics."

The following officers were elected for the coming year.

President—Mrs. E. E. Speer, Decatur, Ala.
Vice President—Mrs. H. N. Lee, Opp, Ala.
Secretary—Mr. Lester M. Garrison, Sneed Junior College, Boaz, Ala.

J. Eli Allen
State Representative

On Saturday, April 19, at the Lake Shore Athletic Club, the Women's Mathematics Club of Chicago and Vicinity held its April luncheon meeting at 12:00 o'clock.

Professor M. B. Gamet of the Civil Engineering Department, discussed the importance of Mathematics in the curricula of, Northwestern University's new Technological Institute.

Miss Beulah Shoesmith of Hyde Park High School and Miss Bernice von Horn of Du Sable High School gave short talks on current problems in the teaching of Mathematics.

Miss Jennie Aasen of Du Sable High School, Mrs. Nona Daugherty of Austin, Mrs. Winnie Mead of Lane, and Miss Anne Gustafson of Lake Forest were the hostesses at this meeting.

Lenore H. King
Chairman, Publicity Committee

In 1939 the Association of Teachers of Mathematics of New York City sponsored a series of radio talks on mathematics for the pupils of New York City. These talks were so favorably received by pupils and teachers that the Association decided to publish them. A pamphlet containing the twenty-two talks has just appeared.

These talks will appeal to children of all levels of attainment. Pupils in the seventh and eighth grade will understand "The Story of Weights and Measures" and "The Story of Numbers." Those who have had geometry will appreciate the talk on geometries other than Euclidean. All (including teachers) will enjoy "The Play of the Imagination in Mathematics."

Copies of the radio talks may be secured by writing to Miss Etta Greenberg, Washington Irving High School, 40 Irving Place, New York City. The price is 35¢ per single copy, 30¢ each in lots of forty, or 25¢ each for a hundred or more.

The National Council of Teachers of Mathematics voted at its recent annual meeting in Atlantic City to change the name of the Visual Aids Committee of the Council to *Multi-Sensory* Aids Committee and to print the final report of this committee as the Eighteenth Yearbook. The chairman of the Committee Dr. E. H. C. Hildebrandt of the State Teachers College at Montclair, N. J., requests mathematics teachers who are interested to take an active part in the preparation of this yearbook.

A tentative general plan for the yearbook calls for three divisions, such as:

I. Expository papers on the various aids to mathematics teaching. This is to include:
   1. History of mathematical models and aids
   2. Equipment for films, slides and film slides
   3. Teacher-made mathematical films
   4. Mathematical models for the following levels:
      a. elementary school
      b. junior high school
      c. senior high school
      d. junior college
   5. Materials for making models
   6. Geometric solids
   7. Three dimensional pictures
      a. Stereograms
      b. Vectographs
   8. Tools of mathematics
   9. Mathematical instruments
   10. The mathematics laboratory and classroom
   11. Techniques of Use

12. Suggestions for further development of aids in mathematics.

(Some of these papers already have been submitted. Arrangements for others are now in process.)

II. Short descriptions of models, devices and other aids.

(It is hoped to have twenty or more short descriptions of those materials which have been used by teachers in their classrooms. We should like to have as many original suggestions sent in as possible. Each paper should be concise—perhaps not more than a typewritten sheet, plus a picture or diagram.

III. Bibliography

(The list of titles given in the preliminary report will serve as a nucleus. However, there should be at least twice that number of titles before this work is completed.)

It will of course be necessary to have a large number of pictures and diagrams in this book in order to make the report as complete as desired.

An Invitation to Teachers

A great deal of the real progress that is made in the teaching profession is made by the classroom teachers. The regular classroom teachers are constantly devising new techniques, striking illustrations, and procedures that are unusually successful. Many busy teachers do not have the time to prepare lengthy magazine articles and thus valuable contributions to the art of teaching are lost—and, unfortunately, these teachers never receive recognition for their efforts.

In the hope of discovering and preserving new techniques and successful devices in the teaching of arithmetic and high school mathematics, teachers are invited to submit contributions. These contributions may be brief—100 to 500 words—and should be mailed to The Art of Teaching Editor, The Mathematics Teacher, 525 West 120th Street, New York City.

The nation's first center where engineers, mathematicians, technicians and other specialists in defense production can devote their full time intensively to problems of higher mathematics as applied to industry will be set up at Brown University this June, President Henry M. Wriston of Brown announced tonight.

Beginning with a summer session which can be continued through the academic year 1941–42, the special training program is being launched as an answer to what a committee of the National Research Council, reporting to the National Resources Planning Board, describes as a "critical need" in the country's defense efforts.

"Before the war the United States depended upon Germany and other European countries in applying mathematics to industrial problems," President Wriston pointed out. "Today adequate exploitation of aerodynamics and other fields bearing directly upon defense activities must await the basic work of mathematicians in this country.

"There is a vital need for some center where men can obtain a broad training in the advanced reaches of mathematics as applied to engineering, and where they can catch the spirit of research and learn the necessary techniques.

"The program at Brown will have the double purpose of serving the nation's defense needs, and of pointing the way to a possible means of solving some of the more difficult engineering problems in peace-time industry.

"The new center of applied mathematics will bring together the few excellent men who are now so widely scattered that their work is relatively ineffective for instruction purposes. They will be able to meet the urgent necessity of passing on their knowledge to others as well as to broaden and enrich their own productive efforts."

Brown has accordingly gathered a group of professors, lecturers, research directors and experts associated with industry, who will come to the university from all parts of the nation. They represent "the most outstanding men available" in the field of applied mechanics, President Wriston said.

Four courses in applied mechanics are to be offered—"Partial Differential Equations," "Fluid Dynamics," "Elasticity," and a seminar for weighing current research problems in elasticity and fluid dynamics. As applied to particular engineering problems, the work of the summer session will deal with highly specialized phases of aeronautics, stresses in machinery, ship construction, ballistics and the detection of submarines and planes.

The program as a whole will become part of the Engineering Defense Training Program of the United States Office of Education, and has been endorsed by members of the War Preparedness Committee of the American Mathematical Society, the Mathematical Association of America, and the Committee on Survey of Research in Industry.

With the cooperation of the United States Office of Education and aided by a grant of funds from the Carnegie Corporation of New York, the center will require no tuition from its students. If the summer session is successful, Brown plans to introduce a full year of similar studies during 1941–42 and to offer fellowships ranging in amounts up to $600.

"Brown University is already a center of instruction in mathematics and has exceptional facilities for the new center," President Wriston said. "The international abstracting journal, *Mathematical Reviews*, is edited here. The faculty of the university includes outstanding men in the fields of analysis, ballistics, the theory of probability, and acoustics.

"The mathematics library at Brown is decidedly superior, and with other books relating to applied mechanics there are approximately 47,000 volumes. Practically all of the journals in pure mathematics are received as well as a

large number in applied mathematics and engineering."

The courses and research opportunities to be offered during the summer will be for (1) giving additional training to men who have used or who want to use mathematics in handling advanced engineering problems, (2) initiating competent students into research in this field, and (3) directing the attention of mathematicians and others to urgent need for research workers and to possible means of meeting this need permanently.

Brown expects that a number of students will come directly from industries. These students will be asked to bring with them problems which require mathematical formulation and solution. Instructors and advanced graduate students in mathematics will also be enrolled.

A maximum of 60 will be accepted, according to Dean Roland G. D. Richardson of Brown's Graduate School, who is in charge of the program. All candidates must have already had considerable experience in various branches of higher mathematics, physics and mechanics, amounting to the equivalent of a year's graduate study.

Sessions will begin on June 23 and will continue for 12 weeks until Sept. 13. There will be five lectures a week in each course and at least as much time will be given over to informal conferences.

Students with special problems will be given additional guidance by staff members who have had industrial experience. Small groups will be formed to work under guidance on problems concerned with defense industries.

The Information Exchange on Education and National Defense, which has recently been organized in the U. S. Office of Education as a clearing house for ideas and materials on education and national defense, announces its first catalog. It lists 103 items which have been organized into 24 loan packets. Publications, posters, outlines, study units, pictorial booklets, reprints of magazine articles all touching on some defense plan or problem are listed in the catalog. They come from institutions as widely separated as Seattle, Wash., and Columbia, S. C. By discovering and using new ideas, democracy uses its resources of ingenuity. Loan packets listed are made up of materials contributed by schools and colleges, organizations and other interested individuals and groups.

Each loan packet contains a number of different materials related to a particular topic, as:

The Role of the Schools in the National Emergency
Understanding and Practicing Democracy
Improving School and Community
Conserving the Nation's Natural Resources
Building and Preserving Good Health
Understanding the World About Us
Vocational Education and National Defense
Libraries and National Defense

Some packets contain materials entirely within one field, such as elementary or secondary. Others contain materials of more general interest and value in two or more fields (elementary, secondary, adult, and higher education).

Materials may be borrowed for a period of two weeks from the time they are received. Franked envelopes or franked labels are provided for the return of the materials without payment of postage. When materials are returned, others may be requested.

A copy of the catalog listing these materials may be secured by writing to Information Exchange on Education and National Defense, U. S. Office of Education, Federal Security Agency, Washington, D. C.

Claremont College of Claremont, California, is offering for the 1941 summer session a workshop in education for teachers, supervisors, and administrators. The 1941 Workshop, directed by Mr. Guy Fox, Assistant Director of the Department of Instruction, Denver, Colorado, is stimulated by Claremont's association with the Commission on Teacher Education of the American Council on Education.

The mathematics offerings include a seminar in the teaching of secondary school mathematics and curriculum study in the workshop group, under the direction of Mr. John E. Alman, Lincoln School of Teachers College, New York. A feature of the program will be a week's conference on Senior High School mathematics with panel discussions on experimental approaches to the curriculum led by teachers experimenting in the field. Teachers and supervisors in the area are invited to attend and enter into the discussions. Further information may be obtained from Dr. Hollis P. Allen, Director of the Summer Session.

The convention of the Kansas Association of Teachers of Mathematics and Kansas Section of the Mathematics Association of America held in Manhattan, April 3, 4, and 5, was very good this year and unusually well attended. Mrs. Adelle Davis, Wichita, president of the K. A. T. M. and Mr. G. Bailey Price, Lawrence chairman of the Kansas Section of M. A. A., presided.

The general theme was Mathematics and National Defense. In a joint symposium with the Kansas Academy of Science, Dr. L. C. Heckert of K. S. T. C., Pittsburg, spoke on "Kansas Resources and National Preparedness," in which he urged that industries for processing natural resources be brought to the state and he told of Pittsburg's efforts to bring an ammonia plant to that town.

Ammonium nitrate is a very important component of explosives, and listeners were amazed to learn that where bombs of the first world war contained no more than 19½ pounds of explosive, the Germans are now using bombs containing from 1700 to 3600 pounds of explosive. Our present supply of ammonium nitrate would supply just 12 bombs per year per plane.

Dr. William L. Hart, Professor of Mathematics at the University of Minnesota, spoke on "Mathematics and National Service." Dr. Hart said that most of the skilled workers now engaged in national defense work, have to be able to work with mathematics. The various problems of defense deal with ballistics, aerodynamics, navigation, gunnery and fire control, analysis for codes and ciphers, probability and statistics.

The Association was fortunate in obtaining Miss Mary A. Potter, the president of the National Council of Teachers of Mathematics as one of the speakers. She discussed the composition of the Council, and also gave a talk on "Donald the Dull."

Miss Potter said that the dull child is emotionally unstable, twice as repressed as the normal child, and inferior in manual accomplishments. She regards the lowering of requirements as detrimental to the superior students, and instead recommends homogeneous grouping as one of the best solutions. Subject matter should be differentiated because although a great many topics are beyond Donald the Dull's ability, he can and likes to solve simple equations and make easy substitutions. His greatest need is a good teacher. He must be an excellent psychologist, have infinite patience, and be one of whom it can be truly said, "he is as wise as a serpent and gentle as a dove."

LOTTCHEN LIPP HUNTER.

The Spring meeting of the Connecticut Valley section of Teachers of Mathematics in New England, held its annual meeting on Saturday April 19, 1941 in the Hartford High School.

PROGRAM

Morning Session

10:30—Address of Welcome: Dr. Thomas J. Quirk, Hartford Public High School, Hartford, Connecticut

10:45—Ballistics: Lieutenant Colonel E. M. Ayer, Ordnance Department, Springfield, Massachusetts

11:45—Mathematical Problems in National Defense: Professor J. Sutherland Frame, Brown University

1:00—Luncheon at the School

Afternoon Session

2:00—Business Meeting

2:15—Some Possible Teaching Aids in Mathematics: Mr. Charles W. Peterson, Newtonville, Massachusetts

3:15—Mathematics and Orthodontics: Dr. Vincent P. Marran, Jr., Holyoke, Massachusetts

OFFICERS OF
THE CONNECTICUT VALLEY SECTION

Marie Litzinger, President
Mount Holyoke College
William G. Shute, Vice-President
The Choate School
Maytscherl Walsh, Secretary
Bulkeley High School, Hartford
Ethelyn M. Percival, Treasurer
Westfield High School
Leland W. Smith, Director
Classical High School, Springfield
A. E. Andersen, Director
Massachusetts State College

PAST PRESIDENTS

Harry B. Marsh	'20
Percy F. Smith	'21
M. M. S. Moriarty	'22
Eleanor C. Doak	'23
Joe G. Estill	'24
Joshua I. Tracey	'25
*Lyon L. Norton	'26
*John W. Young	'27
Rolland R. Smith	'28
Harriet R. Cobb	'29
Melvin J. Cook	'30
Bancroft H. Brown	'31
Dorothy S. Wheeler	'32
H. W. Dadourian	'33
David D. Leib	'34
Nelson A. Jackson	'35
Frederick Mockler	'36
William Fitch Cheney, Jr.	'37
Sarah K. Everts	'38
Leland W. Smith	'39

*Deceased

The Kentucky Council of Mathematics Teachers, which is affiliated with the National Council, had its annual spring meeting in connection with the Kentucky Educational Association in Louisville on April 18. The guest speaker was W. W. Hart of Wisconsin whose topic was, "A Two-Lane Mathematical Highway?" There were present about two hundred, and at the luncheon meeting at noon, there were 40 present. Prof. C. G. Latimer of the University of Kentucky spoke at the luncheon on the strengthening of the position of mathematics in the schools. The president, Miss Cottell Gregory of Louisville, a teacher in the city schools, presided at both meetings.

The officers for the coming year are: President, Miss Tryphena Howard, Assistant professor of mathematics, Western Kentucky State Teachers College, Bowling Green, Kentucky; Secretary-treasurer, Miss Edith Wood, teacher of mathematics, Okolona High School, Jefferson County, Kentucky.

TRYPHENA HOWARD